Interim Corrective Measures - Groundwater Recovery and Treatment System Post Closure Monitoring Work Plan Franklin Power Products Site Franklin, Indiana

Prepared for:
Amphenol Corporation

Prepared by:
SECOR International Incorporated
120 E. Washington Street Suite 421
Syracuse, NY 13202

March 2000

This Interim Corrective Measures - Groundwater Recovery and Treatment System Work Plan (Work Plan) describes "Additional Work" to be completed pursuant to Paragraph N, Section VIII of the Administrative Order on Consent (AOC) for Corrective Measures Implementation (CMI), United States Environmental Protection Agency (USEPA) I.D. #IND 044 587 848, for the Franklin Power Products Site (the Site) in Franklin, Indiana. This Work Plan supersedes the "Work to Be Performed" requirement for paragraphs E, F, G, H, and I of the Order, accepted by USEPA on February 7, 2000.

The following details the "Additional Work" to be implemented at the Site:

Groundwater Recovery and Treatment System - Operations and Maintenance

The existing Groundwater Recovery and Treatment System (GRTS) consists of four groundwater recovery wells and an countercurrent "shallow tray" air stripper. Subsequent to treatment, recovered groundwater is discharged to the sanitary sewer.

To ensure that the GRTS is functioning properly, operation and maintenance (O&M) inspections of the system will be performed. The O&M inspections will include bi-weekly maintenance, monthly maintenance, and quarterly sampling and analysis.

Bi-weekly maintenance will include the following:

- Record groundwater flow meter readings for the four existing recovery wells;
- The inspection of manholes for water leaks along the influent and effluent lines, and at the air stripper;
- Record the back pressure reading on the air stripper. Back pressure readings will be taken while the air stripper and recovery well submersible pumps are operating;
- Obtain groundwater elevation measurements in the four existing groundwater recovery wells;
- Observe and record the effluent clarity in the sanitary sewer manhole outfall;
- Record the ambient air temperature within the treatment system building; and
- Provide repairs to the GRTS as necessary.

In addition to the bi-weekly inspections, monthly maintenance will include:

- Check for scale build-up on the air stripper trays and effluent discharge line. Clean or replace as necessary; and
- Replacement of sediment filter cartridges on influent water lines.

Quarterly sampling and analysis will include:

- Collect groundwater samples from the four existing recovery well influent lines;
- Obtain one effluent sample from the air stripper discharge line; and

- Laboratory analyses of the influent and effluent groundwater samples for volatile organic compounds (VOCs) according USEPA Method 8260B.

Groundwater Elevation Monitoring

To evaluate site groundwater flow patterns and the effectiveness of the recovery system to hydraulically control the off-site flow of groundwater, groundwater elevations will measured from the 16 existing site monitoring wells on a semi-annual basis. These wells include: IT-2, IT-3, MW-3, MW-9, MW-12, MW-20, MW-21, MW-22, MW-23, MW-24, MW-25, MW-26, MW-27, MW-28, MW-29, and MW-30. The locations of these wells are shown on Figure 1.

Groundwater elevations will be collected using an electronic oil/water interface probe. Prior to collecting groundwater elevations from each monitoring well the electronic oil/water interface probe will be cleaned using a non-phosphate detergent and rinsed with distilled water. In addition to the groundwater elevation (depth to water), the total depth of the well will measured.

Groundwater Sampling and Analyses

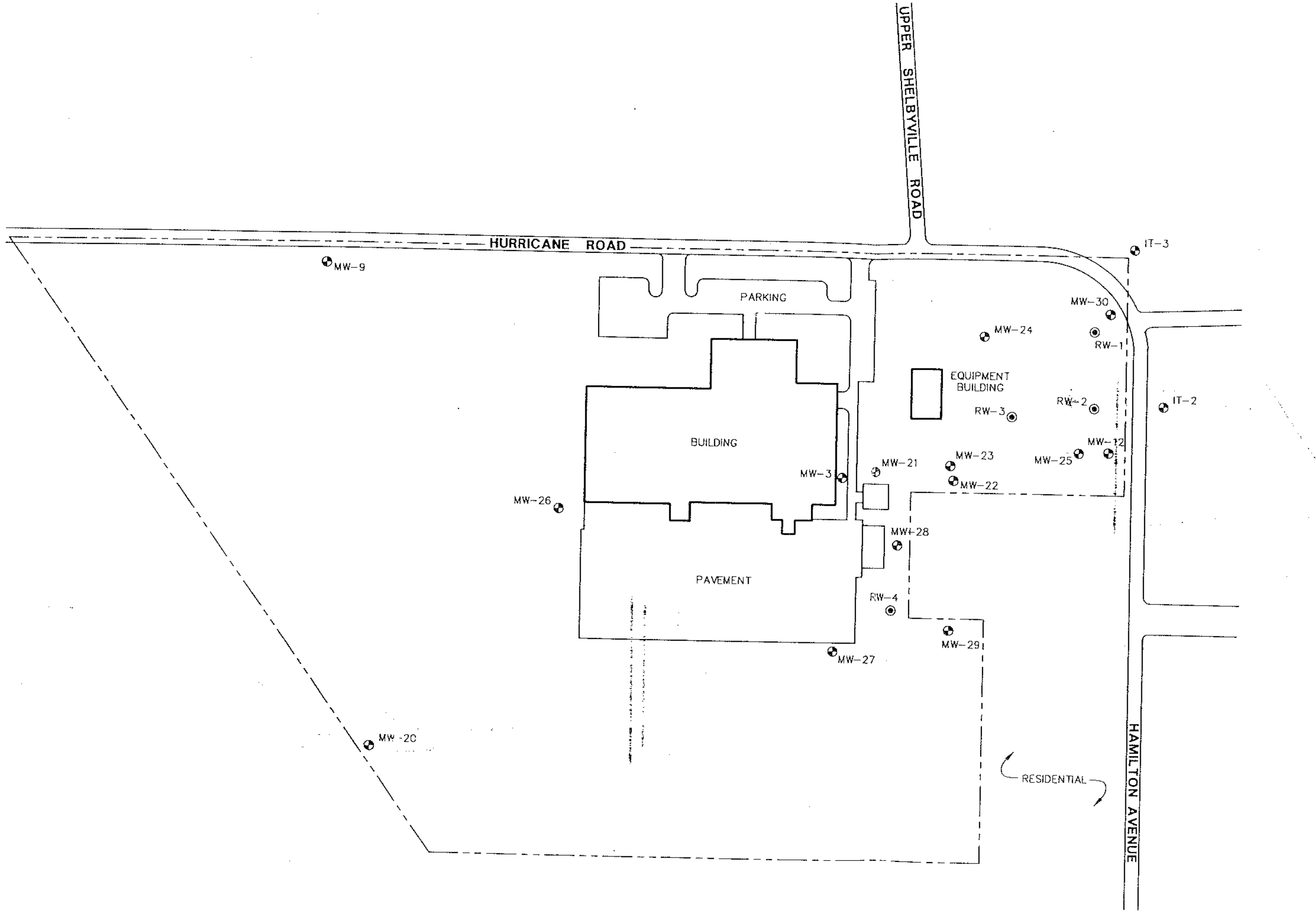
To assess on- and off-site groundwater quality, groundwater samples will be collected from select monitoring wells on a semi-annual basis. Wells to be sampled will include: IT-2, IT-3, MW-12, MW-20, MW-22, MW-28, MW-29, and MW-30.

To reduce the potential of cross contamination, groundwater samples will be collected from each well using dedicated, bottom loading, disposable bailers attached to an adequate length of polypropylene. Prior to sample collection, the stagnant water column in each monitoring well will purged. A minimum of three well volumes of water will be purged prior to sampling. In the event that the well is purged to dryness, the well will be allowed to recharge until an adequate quantity of water is present for sampling. During the purging of each well, an aliquot of water will be retained and field analyzed for temperature, pH, and specific conductivity. These field data, including depth to water, depth of well, and purge water volumes, will be recorded on a groundwater sampling log. Purged water will be retained and transferred to the on-site GRTS for treatment prior to discharge.

Subsequent to purging, a groundwater sample will be collected for laboratory analysis. Collected groundwater samples will be sent to a certified laboratory using proper chain of custody procedures, and analyzed for VOCs according to USEPA Method 8260B. Groundwater sampling procedures are presented in Appendix A. Chain of Custody procedures are presented in Appendix B.

Reporting

Subsequent to each semi-annual groundwater elevation monitoring and sampling and analyses event, a letter report will be prepared. The semi-annual reports will include a summary of groundwater flow conditions, groundwater quality data, and a discussion of the over-all effectiveness of the GRTS. The report will also contain monthly GRTS - O&M Reports, groundwater sampling logs, and laboratory data sheets.



LEGEND

- - - - PROPERTY LINE
MW-30 MONITORING WELL
RW-1 RECOVERY WELL

NOTES:

1. BASE MAP ADAPTED FROM COPY OF HANDEX DRAWING ENTITLED "SITE MAP", DATED 9/27/99.
2. ALL LOCATIONS ARE APPROXIMATE.

DIRECTORY: SECOR/074A
FILE NAME: 074B01
DATE: 2/26/00

SECOR INTERNATIONAL INCORPORATED 120 EAST WASHINGTON STREET SYRACUSE, NEW YORK 13202 315-475-9204	SCALE: 0 100' 200'	PROJECT NO.: 074A DATE: FEBRUARY 2000	CLIENT ---- ---- ----	LOCATION: FORMER AMPHENOL RFI/CMS 980 HURRICANE ROAD FRANKLIN, INDIANA	**SITE PLAN**	FIGURE NO.: **1**

APPENDIX A

GROUNDWATER SAMPLING PROCEDURES

The following procedures will be used to obtain representative groundwater samples from monitoring wells and the groundwater recovery wells and treatment system.

Monitoring Wells

Procedures for well purging and sampling are outlined as follows:

Initial Procedures

1. On the Well Sampling Field Log (attached), identify the Site Information and number of the monitoring well to be sampled. At this time, the sampler should put on a pair of clean latex rubber or vinyl gloves. Cut a slit in the center of a polyethylene sheet and position it over the well creating a clean surface on which the sampling equipment can be positioned. If site or weather conditions prevent the use of the polyethylene sheet (i.e., obstructions, heavy wind, ice, snow, etc.), the sampler should keep the sampling equipment of the ground in a clean area.

2. Using an electronic water level probe, measure the depth to the groundwater table and total depth of the well. The well probe should be rinsed with distilled water prior to use. Both measurements should be taken from a permanent, common, surveyed datum. Measurements should be to the nearest hundredth of a foot. These measurements must be taken prior to purging as they are used to calculate the volume of groundwater present in the well. Record this information on the Well Sampling Log. Compute the volume of water in the well using the formulas provided on the Well Sampling Log, and record this information in the spaces provided.

3. Attach an appropriate length of new polypropylene rope or single stand monofilament line long enough to reach the bottom of the well, to a dedicated bottom loading bailer. Carefully, lower the bailer into the well, to a depth appropriate to fill the bailer approximately half full. Slowly, pull the bailer out of the well making sure to keep the rope on the plastic, or off the ground if plastic sheeting is not being used. Empty the recovered groundwater from the bailer into a clean, clear glass container to observe its appearance. Record the physical appearance of the groundwater (color, odor, turbidity). In addition, check for the presence on light non-aqueous phased liquid (LNAPL). Repeat the procedure, lowering the bailer to the bottom of the well and check for the presence of dense non-aqueous phase liquid (DNAPL). Record this information on the Groundwater Field Sampling Log.

Well Purging (Evacuation) Procedure

1. Initiate the purging process by lowering the bailer to the bottom of the well. All recovered groundwater should be poured from the bailer into a container of known volume in order to measure the volume withdrawn from the well.

2. Continue purging the well until a minimum of three (3) well volumes (as previously calculated) of groundwater have been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time for the well to recover before sample collection. Record the volume of groundwater purged from the well on the Groundwater Sampling Field Log.

Groundwater Sampling Procedure

1. Once the monitoring well has been purged and allowed to recover sufficiently, samples can be collected. Remove the sample bottles from their transport containers, and in preparation to receive samples. Pre-cleaned sample bottles should be obtained from a certified analytical laboratory or distributor. Sample bottles should be kept cool with caps on until ready to receive the groundwater samples.

2. To minimize agitation of the water column, initiate sampling by slowly lowering the bailer into the well. Submerge the bailer far enough into the water column to completely fill it. Upon retrieving the sample, immediately begin filling the sampling bottles. Add appropriate preservatives as necessary. If sampling for VOCs, always fill these containers first; completely fill the VOC container and check to ensure that no air bubbles are present in the sample. Appropriately label each sample, and return each sample bottle to its proper transport container (See Labeling, Packaging, and Documentation).

3. Subsequent to filling, preserving, and placing the samples in their appropriate transport containers, retrieve an additional sample of the groundwater. Place the additional sample into a clean glass container and measure the pH, specific conductivity, and temperature using appropriate field instruments. All field instruments should be calibrated according to the manufacturer's specifications or as outlined in their respective equipment operation manuals, prior to use. In addition, observe the physical appearance of the groundwater sampled (i.e., color, turbidity, odor, etc.) Record these data on the Groundwater Sampling Field Log.

4. Replace the well cap, and lock the well protection assembly before leaving the well location. Place the rope, gloves, plastic sheeting, and any other disposable materials used during the well sampling in a plastic bag for disposal.

Treatment System Sample Taps

The following procedures will be used to obtain representative samples from the sample collection taps located on the groundwater recovery and treatment system:

1. Remove the samples bottles from their transport containers, and in preparation to receive samples. Pre-cleaned sample bottles should be obtained from a certified analytical laboratory or distributor. Sample bottles should be kept cool with caps on until ready to receive the groundwater samples.

2. Fully open the sample taps and allow water to run for not less than 10 seconds.

3. Prior to sampling, reduce flow to minimize turbulence, entrained air, and agitation.

4. Subsequent to obtaining the sample, add appropriate preservatives as necessary. If sampling for VOCs, always fill these container first; completely fill the VOC container and check to ensure that no air bubbles are present in the sample. Appropriately label each sample, and return each sample bottle to its proper transport container (See Labeling, Packaging, and Documentation).

5. Subsequent to filling, preserving, and placing the samples in their appropriate transport containers, retrieve an additional sample of the groundwater in a clean glass container and measure the pH, specific conductivity, and temperature using appropriate field instruments. All field instruments should be calibrated according to the manufacturer's specifications or as outlined in their respective equipment operation manuals, prior to use. In addition, observe the physical appearance of the groundwater sampled (i.e., color, turbidity, odor, etc.) Record these data on the Groundwater Sampling Field Log.

Labeling, Packaging, and Documentation

Sample bottle should be properly labeled with the following information: job number, sample location, sample identification (monitoring well number, sample port number, etc.), date, time, sampler's name or initials, preservative(s) used, and type of analysis required. Immediately after labeling, the samples should be placed in an insulated container or cooler. The temperature of the container or cooler should be maintained at 4 degrees Celsius (°C). The samples must never be allowed to freeze.

Subsequent to collecting each sample or set of samples, Chain-of-Custody documentation should be initiated (See Appendix B). The Chain-of-Custody documentation will accompany the samples from the point of collection to delivery to a certified analytical laboratory. Care must be taken to insure that data placed on the field logs and sample labels is identical to the information transcribed on the Chain-of-Custody documentation form.

APPENDIX B

CHAIN-OF-CUSTODY PROCEDURES

Because any sample is physical evidence of a current situation in the environment, possession must be traceable from the time the samples are collected until are submitted to the laboratory for analyses. To maintain and document sample possession, the following chain-of-custody procedures should be followed:

Field of Custody Procedures

1. Collect only that number of samples which provides a good representation of the media sampled. To the extent possible, the quantity and types of samples and sample locations should be determined prior to the actual field work. As few people as possible should handle the samples.

2. Appropriate field data sheets must be completed at the time of sample collection. In addition, a bound field notebook should be maintained by the project field leader and provide a daily record of significant events. All entries should be signed and dated. All members of the project field team should use this notebook. The notebook should be maintained as a permanent record of the events completed to date.

3. The field sampler is responsible for the care and custody of the samples until they are transferred or dispatched in a proper fashion.

4. The Project Coordinator determines whether proper custody procedures were followed during the field program and decides if additional samples are required.

Transfer of Custody and Shipment

1. Samples should be accompanied by a Chain-of-Custody Record (attached). When transferring the possession of samples, the individuals relinquishing and receiving should sign, date and note the time on the record. This record documents sample custody transfer from the sampler, often through another individual, to the laboratory analyst.

2. Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis. A separate custody record should accompany each shipment (for example, one for each field laboratory, one for samples delivered to the laboratory). Shipping containers will be padlocked or sealed for shipment to the laboratory. the methods of shipment, courier names and other pertinent information should be entered on the bottom of the form.

3. All shipments will be accompanied by the Chain-of-Custody Record identifying its contents. The original record will accompany the shipment, and a copy will be retained by the Project Coordinator.

4. If sent by mail, the package will be registered with return receipt requested. Freight bills, Post Office receipts, and Bills of Lading will be retained as part of the permanent documentation.

ATKEARNEY

A.T. Kearney, Inc.
222 West Adams Street
Chicago, Illinois 60606
312 648 0111
312 223 6200 Fax

RZ2.R05033.01.ID.035

June 26, 1997

Mr. William Buller
U.S. Environmental Protection Agency
77 West Jackson DRE-8J
Chicago, IL 60606

Reference: EPA Contract No. 68-W4-0006; EPA Work Assignment No. R05033; Franklin Power Products - Former Amphenol Corporation, Franklin Indiana; U.S. EPA ID No. IND044587848; Review of the Report of an Evaluation of the On-Site Recovery System; Task 03 Deliverable

Dear Mr. Buller:

This letter report presents A.T. Kearney's review of the Report of an Evaluation of the On-Site Recovery System (ORS) for the Former Amphenol Facility. A diskette is included with an electronic copy of this letter formatted in WordPerfect 6.1 for Windows.

Per your request, A.T. Kearney's review of the ORS focussed on determining whether the recommendations presented in the document appear adequate to effectively achieve the ultimate goal of the ORS. Based upon our review, it appears to A.T. Kearney that the suggested modifications to the ORS seem to have a good chance of successfully controlling the downgradient movement of volatile organics in the groundwater and reducing the level of the contaminated groundwater to below the invert of the storm sewer.

The most notable modification is the replacement of the currently installed pneumatic pumps with smaller electric pumps with equal or greater pumping capacities. The current pumps possess significant limitations since the overall length of the pump and the location of the pump intake severely limits the amount of drawdown that can be accomplished. The proposed replacement of the pneumatic pumps with electric submersible pumps that are much shorter, will allow the pump intakes to be placed much lower in the well. This will effectively allow the pumping rates (and resultant drawdowns) to be increased, by an as yet to be determined amount, thus providing more control over the movement of the plume and the groundwater surface elevation as it relates to the storm sewer invert.

This modification along with the installation of an additional recovery well may result in the ORS achieving the specified goals. However, the effectiveness of the new pumps will have to be evaluated shortly after installation to determine whether operation of the ORS is actually containing migration of contaminated groundwater in the area. If further evalaution of the system concludes that the pumps do not exhibit the necessary control over the groundwater contaminant plume and/or elevation, the next recommendation may be to install up to two additional recovery wells to the east and west of RW-1 and RW-2 respectively. These additional wells would be preferred over the installation of deeper wells since the well screens on the existing recovery wells already extend to the base of the Unit B aquifer. The additional wells would increase the drawdown of the groundwater table over a wider area to ensure that the water table was below the invert of the storm sewer along its entire length.

In summary, based upon our review of the information submitted, it appears that Franklin Power Products should implement the proposed modification at the Former Amphenol Facility in Franklin, Indiana. At this time, we do not feel that the other available options (i.e., deeper wells) are warranted, until and/or unless is it determined that the modifications are ineffective in controlling the downgradient movement of the groundwater plume and/or lowering the potentiometric surface to below the storm sewer invert.

Please feel free to contact me, or Mr. John Koehnen at (312)223-6253 if you have any questions.

Sincerely,

Patricia Brown Derocher

Patricia Brown-Derocher
Regional Manager

cc: F. Norling, EPA Region 5
W. Jordan
J. Koehnen
A. Williams

c:\ehs\33\id035

EARTH TECH
5010 Stone Mill Road
Bloomington, IN 47408-9320
Phone: 812/336-0972 Fax: 812/336-3991

M E M O R A N D U M

Date: June 10, 1997

To: William Buller
US EPA, Region 5, HRE-8J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

cc: Sam Waldo, Michael Jarvis, Thomas Linson, John Bonsett, Rick Littleton

From: James H. Keith, Project Manager JHK
Earth Tech
5010 Stone Mill Road
Bloomington, IN 47408

Subject: **Report of Onsite Recovery System Evaluation Activities at the Former Amphenol Facility; May, 1997**

May Activities

Work continued on the ORS evaluation report, and there was a round of water level measurements conducted on May 20. These were incorporated into the report. A draft ORS evaluation report was completed for internal review.

Problems Encountered

None.

May Activities

The draft ORS evaluation report will be completed and submitted to U.S. EPA Region 5 by June 11.

EARTH TECH
5010 Stone Mill Road
Bloomington, IN 47408-9320
Phone: 812/336-0972 Fax: 812/336-3991

M E M O R A N D U M

Date: May 8, 1997

To: William Buller
US EPA, Region 5, HRE-8J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

cc: Sam Waldo, Michael Jarvis, Thomas Linson, John Bonsett, Rick Littleton

RECEIVED
MAY 13 1997

From: James H. Keith, Project Manager
Earth Tech
5010 Stone Mill Road
Bloomington, IN 47408

Subject: **Report of Onsite Recovery System Evaluation Activities at the Former Amphenol Facility; April, 1997**

April Activities

Four piezometers and one ground water monitoring well were installed in accordance with the Onsite Recovery System Workplan on April 16 and 17. Water levels were measured at all wells and piezometers on April 23. At this time, systems and operational data and characteristics are being evaluated for inclusion in the Evaluation Report.

Problems Encountered

None.

May Activities

A second round of ground water measurements will be conducted during the latter half of May. This information will be added to the previous tapedown data, and operational and performance information in a draft Evaluation Report which will be completed for internal review by the end of the month.

EARTH TECH
5010 Stone Mill Road
Bloomington, IN 47408-9320
Phone: 812/336-0972 Fax: 812/336-3991

M E M O R A N D U M

Date: April 10, 1997

To: William Buller
US EPA, Region 5, HRE-8J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

cc: Sam Waldo, Michael Jarvis, Thomas Linson, John Bonsett, Rick Littleton

From: James H. Keith, Project Manager
Earth Tech
5010 Stone Mill Road
Bloomington, IN 47408

James H. Keith

Subject: **Report of Onsite Recovery System Evaluation Activities at the Former Amphenol Facility; March, 1997**

<u>March Activities</u>

Earth Tech was awarded the contract to conduct the Onsite Recovery System Evaluation at the Former Amphenol Site. A petition was prepared and submitted to the Franklin Board of Public Works requesting permission to install the off-site monitoring well along Glendale Drive. The next Board meeting is scheduled for April 15, 1997 at which time they will act on the request.

<u>April Activities</u>

Drilling for the piezometers and monitoring well is planned for the week of April 14. After the well and piezometers have been installed and developed, they will be surveyed in and top of casing elevations measured. A round of tapedowns for all on-site and off-site wells and piezometers, including the recovery wells, will be conducted. All of the EMCON and Handex records of operation and maintenance to date have been provided by Amphenol, and these will be will be reviewed by the Earth Tech Engineer responsible for preparing the evaluation report.

<u>Problems Encountered</u>

None.

Amphenol

Amphenol Corporation

World Headquarters
358 Hall Avenue
P.O. Box 5030
Wallingford, CT 06492
Telephone (203) 265-8900

RECEIVED
JUN 30 1997
DIVISION FRONT OFFICE
Waste, Pesticides & Toxics Division
U.S. EPA – REGION 5

D.3.2

June 25, 1997

Mr. William Buller
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division, MI/WI Section
US EPA, Region 5 DRE-8J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: On Site Recovery System Evaluation Work Plan - Progress Report
Franklin Power Products/ Amphenol Corporation
IND 044 587 848

Dear Mr. Buller:

In a transmittal dated June 10, 1997, the On Site Recovery System Evaluation Report was submitted to EPA in conformance with your letter of February 25, 1997. If you have any questions or require clarification of any of the information included therein, please contact me.

Also enclosed is a copy of the June 23, 1997 summary of O&M and gauging activities completed by Handex Environmental, Inc. A brief description of planned activities for July is included in their report.

The remaining open issue from your February 25, 1997 letter concerns the placing of deed restrictions on the Franklin facility. As I noted in our telephone conversation of June 23, 1997, I have reminded Franklin Power Products of EPA's position regarding this matter and, at your recommendation, suggested that their attorney contact Larry Johnson of EPA's Regional Counsel's office directly to discuss the specifics of the proposed restriction. You indicated in our telephone conversation that, absent a deed restriction, EPA would be obliged to place residential cleanup standards on the facility.

Should you have any questions regarding the above, please call me.

Yours sincerely,

Samuel S. Waldo
Director, Environmental Affairs

cc: J. Michael Jarvis, Franklin Power Products
Michael Sickles, IDEM
Plinio Perez, Esq.

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Amphenol

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April 18, 1997

D. 3. 1

Mr. William Buller
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division, MI/WI Section
US EPA, Region 5   DRE-8J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: On Site Recovery System Evaluation Work Plan - Progress Report
Franklin Power Products/ Amphenol Corporation
IND 044 587 848

Dear Mr. Buller:

By memorandum dated April 10, 1997, Jim Keith of Earth Tech has provided you with a current status of actions taken pursuant to the On Site Recovery System Evaluation Work Plan. As you may have gathered from that report, Earth Tech was awarded the contract to conduct that assessment. An additional copy of the Earth Tech memorandum is attached.

Also enclosed is a copy of the April 9, 1997 summary of O&M and gauging activities completed by Handex Environmental, Inc. A brief description of planned activities for April is included in their report. Handex has reported recurring operational problems with the recovery well pump controllers. Because of these problems, one of the issues to be addressed in the Earth Tech evaluation will be pump and controller reliability.

Should you have any questions regarding the above, please call me.

Yours sincerely,

Sam Waldo

Samuel S. Waldo
Director, Environmental Affairs

cc: J. Michael Jarvis, Franklin Power Products
Michael Sickles, IDEM
Plinio Perez, Esq.

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Amphenol

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RECEIVED
MAR 18 1997
DIVISION FRONT OFFICE
Waste, Pesticides & Toxics Division
U.S. EPA – REGION 5

D.3.1

March 17, 1997

Mr. William Buller
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division, MI/WI Section
US EPA, Region 5 DRE-8J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: On Site Recovery System Evaluation Work Plan
Franklin Power Products/ Amphenol Corporation
IND 044 587 848

Dear Mr. Buller:

We are in receipt of Paul Little's letter of February 25, 1997 regarding Respondents implementation of the On Site Recovery System Work Plan. We are puzzled that EPA regarded Respondents' concerns about certain aspects of EPA's conditional approval as a "rejection" of those conditions. We believe that there were valid questions regarding the scope of work proposed and that the resolution of those questions could have affected the level of activity at the site. There was no intent on the Respondents' part to be recalcitrant in any way. Nevertheless, we are proceeding to implement the Work Plan as conditionally approved by EPA. A report of those activities will be submitted to EPA by June 11, 1997 (100 days from the March 3, 1997 receipt of Mr. Little's letter). In addition, the fourth piezometer and the Glendale Drive monitoring well will be located as requested by EPA.

As indicated in Respondents letter of January 28, 1997, monthly progress reports will be submitted during the course of implementing and preparing the Work Plan, although Respondents do not waive their right to dispute the authority to require it under the terms of the RFI/CMS Administrative Order on Consent. Please consider this letter as the initial submittal. I have included the monthly progress reports received from our O&M contractor for January and February per your request. In addition and as requested in Section XI of the AOC, please be advised that a request for proposals to implement the Work Plan has been sent out with bids expected by March 21, 1997. Selection of a contractor will be made as soon as those bids are reviewed. Notification of the selected contractor will be provided in next month's progress report.

Mr. Little's letter also reiterates EPA's recommendation to initiate deed restrictions for the Franklin facility in advance of the selection of recommended remedial alternatives. We do not intend to discuss the matter of timeliness of such an action in this letter although those issues may require further consideration. More important is the issue of responsibility for placing such a restriction on the deed. As indicated in my earlier letter, Amphenol does not own the property in question and, therefore, is **not** legally able to place a restriction on the deed. Even though Amphenol is approaching this project in the spirit of cooperation and compliance, and clearly understands its responsibilities *vis-a-vis* the corrective action process, it should not be expected to carry out what is legally impossible. Amphenol has advised co-Respondent Franklin Power Products of EPA's request independently of its receipt of a copy of Mr. Little's letter and anticipates that Franklin Power will respond to EPA regarding this matter in a manner satisfactory to all parties concerned.

Should you have any questions regarding the above, please contact me. Furthermore, if you wish to discuss Amphenol's position on the issue of deed restriction in more detail, you can contact Amphenol's counsel, Plinio Perez, at (203)265-8645.

This response is rendered with the objective of achieving a constructive compromise and in no way shall it be interpreted as a waiver of Respondents' rights.

Yours sincerely,

Samuel S. Waldo
Director, Environmental Affairs

cc: J. Michael Jarvis, Franklin Power Products
Michael Sickles, IDEM
Plinio Perez, Esq.

97-10.doc

Is your RETURN ADDRESS completed on the reverse side?

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, 4a, and 4b.
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3. Article Addressed to:

Mr. Samuel S. Waldo
Director of Environmental Affairs
Amphenol Corp.,
358 Hall Ave.
P.O. Box 5030
Wallingford, Connecticut

4a. Article Number

P-140-675-243

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- ☐ Registered
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- ☐ Express Mail
- ☐ Insured
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7. Date of Delivery MAR - 3 1997

5. Received By: *(Print Name)*

Thomas St Onge

6. Signature: *(Addressee or Agent)*

X Thomas St Onge

8. Addressee's Address *(Only if requested and fee is paid)*

PS Form **3811,** December 1994

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CHICAGO, IL 60604
DRE-9J
B. Buller

10

P 140 675 243

US Postal Service
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No Insurance Coverage Provided.
Do not use for International Mail *(See reverse)*

Sent to Mr. Samuel S. Waldo	
Street & Number 358 Hall Ave. P.O. Box 5130	
Post Office, State, & ZIP Code Wallingford, Connecticut	
Postage	$ .55
Certified Fee	1.10
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Return Receipt Showing to Whom & Date Delivered	1.10
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	$ 2.75
Postmark or Date CHICAGO LOOP STA FEB 25	

PS Form **3800**, April 1995

DRE-9J B. Buller

Amphenol

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D. 3. 1

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JAN 29 1996
DIVISION FRONT OFFICE
Waste, Pesticides & Toxics Division
U.S. EPA – REGION 5

January 28, 1997

Mr. William Buller
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division, MI/WI Section
US EPA, Region 5 DRE-8J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: On Site Recovery System Evaluation Work Plan
Franklin Power Products/ Amphenol Corporation
IND 044 587 848

Dear Mr. Buller:

I am in receipt of EPA's approval of the subject work plan by letter dated January 15, 1997 (received on January 21, 1997). Your letter raises several issues beyond the approval of the work plan which prompt some discussion.

You have conditioned approval, in part, on the inclusion of an additional piezometer near the southeast corner of the property. Certainly an additional monitoring point could provide more comprehensive information; we remain firmly convinced, however, that the area where this piezometer would be located is adequately covered by existing and proposed monitoring points and that an accurate representation of hydraulic gradients can be developed with the data collected from those points. In view of the above, we ask that you reconsider your request for this additional point.

You also suggested that the monitoring well proposed for installation on Glendale Drive should be located closer to the southern boundary of the facility to aid in the interpretation of hydraulic gradients. Our intent in locating the well as indicated on Sheet 1 of the work plan was to provide a down gradient monitoring point for long term monitoring of VOCs. The point selected was approximately at the edge of VOC detections. If EPA would prefer to have this well act as a down gradient hydraulic monitoring point, we would agree that it could be placed closer to the facility. If, however, EPA desires a down gradient VOC monitoring point, we would recommend that it be located as described on Sheet 1.

As a second condition of approval, EPA has required submittal of the Evaluation Report within 80 days of approval. Our work plan proposed a schedule of approximately 120 days, proposed after careful consideration of the actions necessary to solicit bids and select a contractor to carry out the work. We do not believe that this can be effectively carried out in 80 days. By expediting certain activities we feel that 100 days is a reasonable compromise. Notwithstanding this, we firmly believe that there is no basis for requiring such a plan in the Administrative Order on Consent (AOC). To that end, we specifically noted in the November 27, 1996 transmittal letter that submission of this plan was completely voluntary. In the spirit of that voluntary action, we would expect EPA to be equally accommodating.

We can find no basis for a requirement to provide monthly progress reports for this work plan in the AOC. Furthermore, a submittal date of five days after the beginning of the next month is particularly onerous. Permit programs which may require the collection and analysis of samples typically provide several weeks after the end of a reporting period for submittal of a report. The NPDES program, for instance, requires the submittal of a Discharge Monitoring Report 28 days after the end of a reporting period. Because a monthly summary of activities is currently being prepared by the contract operators, however, a copy can be provided to EPA. That report is generally available during the second half of the month.

The report prepared by our contractor includes much of the information requested by EPA. We do not, however, monitor maximum, minimum and average pumping rates. Each recovery well is equipped with a totalizing flow recorder; total flow is recorded during each biweekly inspection, with monthly totals provided to the City of Franklin for sewer use billing. A cumulative summary of ground water withdrawn from each recovery well is provided in the monthly report. Also included in the report are the inspection sheets completed during each visit (as well as all responses to system alarms) which include the O&M information you requested. Please advise us if this type of report would satisfy your request.

On another matter, EPA has directed the Respondents to provide a deed restriction limiting use of soil and ground water at the facility, citing the inclusion of a deed restriction in the CMS Report. A deed restriction was listed as a **possible** institutional control, along with use of local regulations restricting use of the site, in a list of a number of potential controls. To single out one particular institutional control, in advance of EPA's designation of a selected remedial measure, is premature. Furthermore, we again find that EPA has no basis to require such an action under the AOC. Irrespective of the above, and as I have noted on several occasions, Respondent Amphenol Corporation has no ownership interest in the property and, therefore, cannot take any action with respect to the deed for that property. Respondent Franklin Power Products would have sole discretion in any actions involving the deed for the property.

Finally, with respect to limiting the future use of soil and ground water, we have conducted additional inquiries into current local and State restrictions on the placement of water wells in areas of potential contamination as well as environmental disclosure requirements. The City of Franklin, Johnson County Health Department, Indiana DEM and Indiana DNR - Division of Water were contacted. None of those agencies were aware of any law or regulation which specifically forbade the installation of wells and/or the withdrawal of contaminated ground water.

Nonetheless, under 310 IAC 16-3-2 (1) and (2)(B), water wells must be located to use every natural protection to promote the maintenance of the well and its surroundings and must be located as far as practicable from any known contamination source. In addition to the above, the Indiana Responsible Property Transfer Law (RPTL - IC 13-7-22.5) requires that any seller of property meeting certain criteria must provide a prospective purchaser with an environmental disclosure document at least 30 days before a transfer takes place. This disclosure would require the notification to a purchaser of the existence of a remedial action at the facility; thus any actions taken by a prospective owner would be with the full knowledge of site conditions.

The requirement for disclosure, coupled with current zoning and Franklin Power Product's plans to retain the property for the foreseeable future mitigate the need for additional proscriptions on future land use as EPA envisions in requiring deed restrictions.

A number of issues were raised in your letter and addressed herein. While the system evaluation is not affected by any additional discussions on deed restrictions, there remain significant issues outstanding on the scope of the evaluation work plan. Because resolution of those issues will affect the timing and extent of the effort, we do not intend to initiate field activities until resolution is reached.

Please contact me should you have any questions regarding any of the above. However, since Amphenol does not own the property, we request that any EPA communications regarding deed restrictions or similar takings of property rights be sent directly to Franklin Power Products.

Yours sincerely,

Samuel S. Waldo

Samuel S. Waldo
Director, Environmental Affairs

cc: J. Michael Jarvis, Franklin Power Products
Michael Sickles, IDEM

OSRSWP

bcc: J. Keith, Earth Tech
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DIVISION FRONT OFFICE
Waste, Pesticides & Toxics Division
U.S. EPA – REGION 5

November 27, 1996

Mr. William Buller
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division, MI/WI Section
US EPA, Region 5 DRE-8J
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: On Site Recovery System Evaluation Work Plan
Franklin Power Products/ Amphenol Corporation
IND 044 587 848

Dear Mr. Buller:

Enclosed please find a copy of an On Site Recovery System Evaluation Work Plan as requested in your letter of September 12, 1996.This work plan incorporates the components outlined in Attachment I of your letter as well as the results of a comprehensive round of ground water samples taken in anticipation of the preparation of this document.

Notwithstanding our willingness to conduct the activities described therein, we find no basis in the Administrative Order on Consent (AOC) for the EPA to require such a work plan. Therefore, the preparation and submittal of the work plan is completely voluntary. Furthermore, we do not consider the work being performed, nor the report to be generated, to be subject to the provisions of Paragraph XVII (Delay in Performance/Stipulated Penalties) of the AOC.

We look forward to receiving your comments on the evaluation plan. Please give me a call if you have any questions or desire additional information.

Very truly yours,

Samuel S. Waldo

Samuel S. Waldo
Director, Environmental Affairs

cc: J. Michael Jarvis - Franklin Power Products
Michael Sickles - IDEM

earth tech

environmental services & remediation transportation engineering & construction total water management

Draft
Report of an Evaluation of the On-Site Recovery System Former Amphenol Facility Franklin, Indiana

Prepared for:

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June, 1997

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FIGURES

TABLES

APPENDIXES

Report of an Evaluation of the

On-Site Recovery System

Former Amphenol Facility, Franklin, Indiana

1.0 INTRODUCTION AND PURPOSE

This Report of an Evaluation of the On-Site Recovery System (ORS) at the Former Amphenol Facility in Franklin, Indiana is prepared in conformance with the document *On-Site Recovery System Evaluation Workplan for the Former Amphenol Facility, Franklin, Indiana*, dated November 1996, and approved by US EPA Region V in a letter dated February 25, 1997 and received by Respondent Amphenol Corporation on March 3, 1997. As specified in the Amphenol March 5, 1997 Request for Proposal for Implementation of the ORS Work Plan, the work presented in this report represents an operational and hydraulic assessment of the recovery system, including an analysis of system components and operation procedures with the goal of maximizing contaminant recovery and drawdown of the potentiometric surface. Specifically, this ORS report provides the following information:

- A description of the project area.
- Installation information for four new piezometers and one new monitoring well, as specified in the ORS Work Plan and U.S. EPA letters dated January 15, 1997 and February 25, 1997.
- A summary of ground water levels in the vicinity of the ORS.
- Updated potentiometric surface contour maps in the vicinity of the ORS.
- An analysis of ORS operations to date, based on monthly reports submitted to Amphenol by EMCON (past system operator) and Handex (present system operator).
- An analysis of ORS operating and maintenance characteristics and capabilities, based on technical information provided by Amphenol and Handex.
- An analysis of the present overall effectiveness of the ORS in achieving stated remediation goals.

- Recommendations for operational or hardware modifications to the system to facilitate and/or complement the installation of Corrective Measures described in the Corrective Measures Study.

2.0 DESCRIPTION OF THE PROJECT AREA

2.1 LOCATION AND PHYSICAL SETTING

The former Amphenol facility covers an area of about 15 acres. It is located in part of the Northwest Quarter of the Northwest Quarter of Section 13, T12N, R4E, on the northeastern side of Franklin, Indiana (Figure 2.1) The property is bounded on the east by Hurricane Road, on the south by Hamilton Street, on the north by an abandoned rail line, and on the west and northwest by a Farm Bureau Co-Op facility and Arvin Industries, respectively. A Grimmer-Schmidt facility is located east of the site across Hurricane Road. To the south, southeast and southwest, the land use is primarily residential. Approximately 6 acres of the property is used by Franklin Power Products subsidiary companies for manufacturing purposes (see next paragraph). The remainder of the property is leased for farming operations or maintained in grass. The site is relatively flat with approximate elevations ranging between 730 and 735 feet above Mean Sea Level (MSL).

The main structure on the site is a 46,000 square foot building formerly used in the manufacture and distribution of electrical connectors. The building is now occupied by International Fuel Systems, Inc., which manufactures fuel injectors for diesel engines, and Marine Corporation of America, which assembles marine diesel engines. Other buildings include a separate wastewater pretreatment building, now used for engine testing, and a small single-bay garage, used for storage. The area surrounding the main building is either paved parking area, driveway, or grass. The property is unfenced.

Surface drainage from a large area north of the property enters a 72-inch storm sewer at an infall located on the Arvin property immediately adjacent to the northwest corner of the property. The location of this storm sewer is shown on Sheet 1. The storm sewer lies along the western property boundary and receives additional flow from a sewer opening on Farm Bureau property located about 450 feet south of the northwest property corner. At the southwest property corner, the storm sewer turns east. Directly south of the main production building, the sewer turns south again and extends to Hamilton Avenue. At Hamilton Avenue, it again turns and runs east along the south property line. The storm sewer crosses under Hamilton Avenue in the extreme southeast corner of the property, and discharges to Hurricane Creek at a point approximately 1,200 feet southeast of the site. Hurricane Creek has a drainage area of about 15.6 square miles above the storm sewer outfall.

Surface drainage from the northern portion of the property enters a low, wide, natural swale that trends northeast-southwest across the property. This swale appears to be internally drained, and the direction of water flow is unknown. The southeastern portion of the property drains southeast to Hamilton Avenue and Hurricane Road, thence into a storm sewer manhole located in the inside of the roadway where Hamilton Avenue turns north into Hurricane Road.

2.2 GEOLOGIC SETTING

The area is located within the Tipton Till Plain physiographic unit, which is generally characterized by low relief topography underlain by thick deposits of glacial drift. The surficial drift deposits are Wisconsinan (Woodfordian) in age and consist primarily of loamy textured diamicts (glacial till) as well as stratified sand and gravel deposits. In many places, older glacial drift deposits of pre-Wisconsinan age have been identified.

Four lithostratigraphic units may be recognized in the upper portion of the glacial drift sequence. Previous soil borings conducted during the period 1984 to 1985 suggest the site is underlain by a thin veneer of weathered glacial till about five to eight feet thick (identified as Unit A in this report) which overlies a sand or silty sand deposit (Unit B) which is saturated in the lower part. The bottom of this sand unit occurs at 712 to 715 feet MSL, or approximately 20 feet below ground surface. The sand overlies a hard, dense till unit 23 to 26 feet in thickness (Unit C), which in turn overlies a second sand unit that is approximately 17 to 20 feet in thickness (Unit D). The bottom of the lower sand unit extends to a depth of about 60 feet below ground surface. Both the lower part of Unit B and Unit D are saturated and yield groundwater.

Deeper drift deposits are known from only one boring (MW-13), but appear to consist primarily of till, with thin stratified units occurring at depths of 114.5, 122 and 172 feet. The lowest "basal sand" unit directly overlies shale bedrock. Bedrock beneath the property is the Devonian-Mississippian aged New Albany Shale (Gray and others, 1987), encountered at a depth of 178.9 feet in boring MW-13.

2.3 HYDROGEOLOGY

Previous water level elevation data from site monitoring wells suggest a fairly uniform north to south groundwater flow gradient within the upper sand and gravel unit. Data gathered by International Technology Corporation (IT) on May 3, 1985 suggest that the 72-inch storm sewer flowing along the south boundary of the property may act at least as a partial intercept for groundwater flow in the saturated portion of Unit B. The water level in well IT-2, located south of the storm sewer, was reported to be over 1.2 feet higher than MW-12 located adjacent to, and north of the sewer. These levels suggest a local reversal of the north to south hydraulic gradient in the storm sewer area.

Hydraulic conductivity of the upper sand unit (Unit B) was estimated by IT from six in situ "slug" tests conducted in the old ATEC Associates (ATEC) monitoring wells (IT, 1985). Calculated values ranged from 3.08×10^{-6} to 9.51×10^{-4} cm/sec. Results may be biased low due to poor well construction, and/or development.

3.0 PREVIOUS ON-SITE ENVIRONMENTAL INVESTIGATIONS AND RESPONSES

The September 1995 CMS report summarizes on-site CMS activities for the former Amphenol facility. Sections 2.0 and 3.0 of that report summarize RFI activities and site activities prior to the RFI.

4.0 EXISTING RECOVERY SYSTEM

The On-Site Recovery System was initially installed as an interim corrective measure (ICM). This section provides a description of the recovery system in its existing condition and describes operation and maintenance activities conducted to ensure that recovery and containment of contaminants are maximized.

4.1 Purpose of the Recovery System

Based on the results of the RFI, and with the concurrence of U.S. EPA Region V, the respondents initiated the design and implementation of the ORS in August 1994. The system was installed by Wehran EMCON Northeast, Indianapolis, Indiana, and began operations the second week of February 1995. Presently, the operation and maintenance (O&M) of the ORS is being performed by Handex, with offices in Indianapolis, Indiana. The objectives of the ORS are to:

1. Withdraw VOC-containing ground water from the uppermost saturated unit (Unit B) and treat the water by air stripping to nondetect levels.
2. Depress the potentiometric surface of Unit B to elevations below the invert of the nearby storm sewer which at times intercepts VOC-containing Unit B ground water and conveys the water to nearby Hurricane Creek.
3. Prevent the further migration of the ground water plume as well as provide localized off-site flow reversal to capture VOC-containing ground water which may have crossed the facility boundary.

4.2 System Description

The recovery system consists of three four-inch recovery wells (RW-1, RW-2, and RW-3) equipped with 5-foot lengths of slotted Schedule 40 PVC screens. The locations of the recovery wells are indicated on Figures 6.2 and 6.3. RW-1 is 18.0 feet deep and the screen interval is from 11 to 16 feet below ground surface (bgs). RW-2 is 21.5 feet deep and the screen interval is from 14 to 19 feet bgs. RW-3 is 23.5 feet deep and the screen interval is from 16 to 21 feet bgs. The casing bottoms extend 2 to 3 feet into Unit C. The associated boring logs and well completion diagrams are shown in Appendix A.

RW-1 presently contains a 3-inch diameter, 36-inch long, Gladiator™ controllerless submersible pneumatic pump with a maximum pumping capacity of approximately 8 gallons per minute (gpm). This pump automatically cycles as soon as the pump fill chamber fills with ground water.

RW-2 and RW-3 contain 3-inch diameter, 60-inch long bottom-filling pneumatic pumps manufactured by Ejector Systems. The pumps are rated for a maximum capacity of approximately 10 gpm. The pumps fill by gravity and are emptied by compressed air supplied to the fill chamber from an air compressor located in the treatment building constructed for the system. The supply of pressurized air to pumps at RW-2 and RW-3 is controlled by Ejector Systems Model S2 pump controllers located in the treatment building. These regulate the filling and emptying cycle times and control the opening and closing of pump valves. They are entirely pneumatic and use a bubbler type liquid level control to gage the height of water in the well for proper opening and closing of valves. Pneumatic lines to the two pneumatic pumps are housed within 4-inch PVC casings that extend below grade from the treatment building to the well heads.

All three ground water pumps are presently operated by a 7.5 horsepower (hp) compressor. Ground water extracted from the recovery wells is pumped to the treatment building via underground lines. Each influent line passes through a pre-filter and flow meter before merging in a manifold that enters the top tray of a three-tray low-profile air stripper with a rated hydraulic capacity of 50 gpm. The ground water then flows by gravity to the bottom chamber (sump) of the air stripper. A 5 hp regenerative blower with a capacity of 400 cubic feet per minute (cfm) forces air upward from the bottom of the air stripper to establish a counterflow with the downward-flowing water. Volatile organic compounds (VOCs) are removed from the ground water by volatilization into the air stream. The treated ground water flows by gravity from the sump through an underground line that conveys the ground water to a nearby sanitary sewer manhole. Air is discharged through an 8-inch exhaust stack at the top of the air stripper.

If a system shutdown occurs, a telephone autodialler notifies operation and maintenance personnel of the shutdown. System shutdown conditions include high or low blower pressure, or high liquid level in the air stripper sump. The autodialler allows O&M personnel to promptly respond once a shutdown has occurred.

4.3 Present System Optimization

Present optimization of the system with regard to maximizing the removal of affected ground water is based on achieving two objectives:

1. Maximizing pumping rates from the recovery wells; and
2. Minimizing system downtime.

These objectives are achieved by a combination of the design and maintenance features described below.

4.3.1 Maximizing Pumping Rates

The controllerless pump installed at RW-1 cycles as soon as its fill chamber fills with ground water. This means that the pump will pump at the rate that ground water enters the recovery well unless the rate of inflow exceeds the pump capacity. The pumping rate will automatically adjust to accommodate increases in the rate of ground water infiltration up to the rated pump capacity.

Pumping rates from RW-2 and RW-3 are maximized by adjusting the fill and empty times of the pumps at the controller to ensure that the pump is cycling at the maximum frequency possible given the infiltration rate of ground water into the recovery well.

4.3.2 Minimizing System Downtime

Recovery system downtime is minimized by conducting routine, scheduled preventive maintenance inspections and maintenance procedures, and by assuring prompt response to shutdowns. System inspections and maintenance activities are conducted on a biweekly schedule and include the following:

- Checking for water or air leaks in the system and repairing as necessary.
- Checking the oil level in the compressor.
- Releasing water condensate from the air compressor.
- Recording pressure, flow meter readings and treatment building temperature.
- Noting effluent clarity in the sanitary sewer manhole.

Other maintenance activities are conducted on monthly, quarterly, or annual maintenance schedules. Some of these activities include:

- Replacing sediment filter cartridges.
- Checking the stripper trays and tubes for lime buildup and cleaning as necessary.
- Pulling recovery pumps and checking valve operation and line connections.
- Changing the oil in the air compressor.
- Checking valve wear, replacing filters, cleaning valves and springs and replacing cylinder bores as necessary in the S-2 pump controllers.

These maintenance activities are conducted to minimize mechanical problems that could lead to system shutdown and downtime for major repairs. The autodialler allows O&M personnel to promptly respond once a shutdown has occurred, rather than waiting to discover the shutdown during the next maintenance visit.

The combination of scheduled preventive maintenance activities and expedited response to system shutdowns ensures that remediation system downtime is minimized.

5.0 METHODS AND MATERIALS

5.1 Piezometer and Monitoring Well Installation

Four piezometers (P-3, P-4, P-5 and P-6) were installed for this ORS evaluation on the former Amphenol property, and one additional monitoring well (MW-35) was installed south of Hamilton and immediately west of Glendale Drive. The purpose of the piezometers was to provide additional information for determining drawdown and ground water capture zones for the ORS. The purpose of the monitoring well is to provide additional information on the downgradient edge of the plume boundary. Figures 6.2 and 6.3 show the locations of the new piezometers and monitoring well, plus the recovery wells and other monitoring wells in the area affected by the ORS.

Completion diagrams are shown in Appendix A. All borings were advanced to the base of Unit B. The piezometers and monitoring well were constructed of 2-inch threaded Schedule 40 PVC pipe. Screens consist of 10-foot lengths of 0.010-inch slotted PVC pipe. The on-site piezometers were completed with stick-up protective covers with locking caps. MW-35 was completed with a flush-mounted protective cover and locking cap. The piezometers and monitoring well were developed by thorough surging.

Following installation, the piezometers and monitoring wells were surveyed to determine location, ground elevation and top-of-casing (TOC) elevation.

5.2 Water Level Measurements

Two round of tapedown measurements were made of all on- and off-site monitoring wells and piezometers and the three ORS recovery wells, the first on April 23, 1997 and the second on May 20-21, 1997. All measurements were made from the top of the well casing to the water surface by means of a Sample Pro 6000 Water Level Meter. All recovery well pumps were operating on both dates. The tapedown data were used to generate maps of the potentiometric surface using 0.25-foot elevation contours (Figures 6.2 and 6.3).

5.3 System Performance Evaluation

The purpose of the ORS system performance evaluation is to assess performance with respect to the capabilities of its present components and configuration, and with respect to the ORS objectives listed in Section 4.1 of this report. ORS information used for this evaluation included:

- The *Former Amphenol Facility Interim Corrective Measure Operations & Maintenance Manual* (Amphenol Corporation, January 1996). This manual contains a general description of the system and its components, detailed startup and shutdown procedures, a maintenance schedule, a list of spare parts, a detailed summary of reporting requirements, and specifications, operating information and maintenance information on individual system components.

- Monthly reports submitted by the system operator to Amphenol. These contain information on ground water level measurements, system operation and maintenance activities, total pumpage by recovery well, and influent and effluent line sampling and analysis. Problems encountered and corrective actions taken are discussed as appropriate, and completed inspection forms and maintenance checkoff sheets are attached.

- Recovery system operational data and ground water hydraulic data. These were evaluated to determine the effectiveness of the recovery pumps used in the existing recovery system. Rated pump capacities were compared to actual pumping rates and available drawdowns were compared to actual drawdowns to determine if the existing pump type and sizing is appropriate to achieve maximum recovery and containment.

6.0 RESULTS

The effectiveness of the existing recovery system in ground water capture and plume withdrawal was determined by evaluating the hydraulic capture zones of the recovery wells. Also evaluated were system reliability and maintenance, the effectiveness of the air stripper in removing VOCs from ground water during treatment, and changes in VOC concentrations in recovery wells over time.

The effectiveness of the recovery system in depressing the potentiometric surface of Unit B below the invert elevation of the storm sewer was evaluated by directly comparing water levels in monitoring wells, piezometers, and recovery wells to the elevation of the storm sewer invert. The drawdown available to the system at each recovery well was also evaluated.

6.1 ORS Capture Zones

Tapedown data for the ORS are shown in Table 6.1. These measurements were conducted by EMCON and Handex, and by Earth Tech in support of this evaluation. Potentiometric surface contours at 0.25-foot intervals are shown on Figures 6.2 and 6.3 for April 23, 1997 and May 20-21, 1997, respectively. The potentiometric surface contours on both figures indicate that the existing ground water recovery system is currently providing hydraulic capture at the downgradient edge of the plume between RW-1 and RW-2. The contour maps also indicate that ground water capture has extended to IT-2 and MW-35, and that ground water flow directions have reversed toward the recovery wells. The ground water capture pattern between RW-2 and RW-3 does not clearly indicate significant ground water capture. This may be due to limited drawdown, the fact that the two recovery wells and piezometer are oriented in the direction of ground water flow, and the presence of the storm sewer.

The contour maps are drawn to indicate depression of the potentiometric surface along the storm sewer between MW-29 and MW-22. This depression was noted during preliminary evaluations of the data using the Surfer™ contouring graphics program using a radial basis mapping function. The depression was judged not to be an artifact of the spatial data array because it parallels the storm sewer in this area, and the storm sewer trench is probably acting to some extent as a conduit in conveying ground water to RW-3. If RW-3 is dewatering of the storm sewer trench in the vicinity of MW-28, then it is expected that ground water flow would generally be easterly and toward RW-3 until ground water levels are below the sewer invert.

It does not appear that the existing ORS is affecting ground water in the vicinity of IT-3. Since the May 20, 1997 ground water level is below the storm sewer invert elevation at the east manhole (Table 6.1), infiltration of VOC-containing ground water into the storm sewer may not be occurring.

6.2 POTENTIOMETRIC SURFACE DEPRESSION

The water levels in site monitoring wells, piezometers, and recovery wells were compared to the elevations of the storm sewer inverts to determine if the existing recovery system was effectively preventing infiltration into the storm sewer. The storm sewer invert elevationss were determined based on surveyed elevations of the inverts in three storm sewer manholes referred to as the north, south, and east manholes (Table 6.2). The manhole locations are shown in Figures 6.2 and 6.3

Table 6.2 shows measured and estimated invert elevations relative to measured ground water levels measured over the past 13 months. Storm sewer invert elevations were estimated by linear interpolation between manholes. The invert elevations decrease in order from north to south to east, corresponding to the flow direction in the storm sewer. As indicated in Table 6.2, the potentiometric surface is generally above the storm sewer invert elevation. Although in one instance, the water level in RW-2 was below the adjacent storm sewer invert (September 12, 1996), the average water level at every ground water monitoring location was higher than the storm sewer invert elevation adjacent to the monitoring location. The seasonal high water level ranged from 1.04 to 2.40 feet above the storm sewer invert at the various monitoring locations.

6.3 RECOVERY WELL YIELDS

The expected well yields were evaluated by analyzing the results from pumping tests at RW-2 conducted in October 1994 by EMCON during ORS installation. The hydraulic parameters calculated from those pump test results, as well as RFI pump test results were used in the design of the existing recovery system. The test consisted of pumping ground water from recovery well RW-2 at a flow rate ranging from 4.0 to 4.4 gpm for the duration of the test. Water level data loggers in monitoring wells MW-12 and IT-2 were used evaluate the aquifer response to pumping. Results from the pumping test indicated an average transmissivity of 10,570 gallons per day per foot (gpd/ft), a hydraulic conductivity of 2,069 gpd/ft^2 and an average storage coefficient of 0.12.

The pump test results were used to calculate a characteristic curve for recovery well RW-2 using the Dupuit-Forchheimer equation for radial flow in an unconfined aquifer. The characteristic curve indicates the expected drawdown as a function of the pumping rate from the recovery well. The Dupuit-Forchheimer equation contains several assumptions that may not be valid based on specific site conditions, but the results give a approximation of yields that can be expected. The calculated characteristic curve is provided in Figure 6.4 The associated calculations, along with a sensitivity analysis, is provided in Appendix C.

The characteristic curve indicates that pumping rates from 10 to 13 gpm are required at this well to sustain a drawdown of 2 to 3 feet. The sensitivity analysis does indicate that variations in the hydraulic conductivity can have a significant affect on these values. In accordance with the Dupuit-Forchheimer equation, the flow rate is directly proportional to the hydraulic conductivity. Therefore, a 50 percent decrease in the hydraulic conductivity reduces the pumping rate required to sustain a specific drawdown by 50 percent.

From the cumulative pumpage data provided in the monthly Handex reports, it appears that RW-1 averaged 1.5 gpm between August 4, 1995 (when a new flow baseline was set for the system) and March 28, 1997. For the period between August 4, 1995 and January 3, 1997 (there was a flowmeter malfunction in later readings), RW-2 averaged 2.0 gpm. For RW-3 during the period between August 4, 1995 and February 21, 1997 (there was a flowmeter malfunction in later readings), the average flow was 2.8 gpm.

6.4 ORS RELIABILITY AND MAINTENANCE

The EMCON and Handex monthly reports and field inspection forms were reviewed for the period June 19, 1995 through May 22, 1997. According to these sources, there were twenty instances when there was a total or partial system shutdown during this period. Two of these instances (EMCON, 10/6/95 and 1/15/96) were not explained in the reports. For the remaining eighteen instances, the following explanations for shutdown were given in the reports:

- Blocked system discharge (lime buildup; freezing) — 5 instances
- Air leaks (compressor, regulator, lines) — 3 instances
- Pneumatic controller malfunction — 3 instances
- Circuit breaker trip, power outage — 3 instances
- Compressor malfunction — 2 instances
- Pump empty/fill timing cycle — 1 instance

- Frozen influent lines 1 instance

It should be noted that nine instances of shutdown were related to pneumatic malfunctions (air leaks, controller malfunction, compressor malfunction and time cycles).

An autodialler was installed in at the building in June 1966 when Handex began operating the system. The autodialler was intended to call the Handex Indianapolis office in the event of high or low pressure is detected in the air stripper, or power is lost. The autodialler signaled a shutdown due to blockage of the discharge pipe to the POTW on November 15, 1996, December 30, 1996 and January 3, 1997. Where other instances of line blockage were noted in the field reports, it was not indicated that the alarm had sounded. Nor was there an alarm for other types of system shutdown.

On May 1, 1996 the pump and discharge hose in RW-1 was replaced with the Gladiator™ controllerless pump now in operation. The replacement was intended to avoid persistent performance and shutdown problems associated with moisture buildup in the RW-1 controller.

On February 7, 1997, Handex found that the 4-inch "P" trap installed in the ORS effluent line between the stripper and the POTW outfall had been reduced to an inside diameter of 2 inches by lime buildup. The trap was removed and replaced with a removable trap that can be removed and cleaned monthly.

On March 14, 1997, the controller was replaced at RW-2, and on April 11, 1997, the controller was replaced at RW-3. Both had experienced recent shutdowns because of controller malfunctions.

6.5 INFLUENT AND EFFLUENT WATER QUALITY

Table 6.3 summarizes influent and effluent water quality for VOCs throughout the life of the ORS. Eight rounds of ground water sampling have been performed at the three recovery wells between May 3, 1995 and May 7, 1997, and seven rounds of system effluent samples.

Six VOC compounds were detected in the recovery well samples during this period: 1,1-dichloroethane (DCA), 1,1-dichloroethene (DCE), cis-1,2-dichloroethene, tetrachloroethene (PCE), 1,1,-trichloroethane (TCA) and trichloroethene (TCE). The values are combined in Table 6.3 to provide an estimate of Total VOCs passing through the system. While Total VOC concentration has fluctuated over the reporting period, there has been a general decline from a level of 11,300 ug/L in May 1995 to a level of 4,889 ug/L in May 1997.

For all sampling periods, VOC levels have been below detection limits in the ORS effluent.

6.6 EXISTING ORS DESIGN ANALYSIS

The recovery well completion diagrams were compared to the measured water levels to determine the average water depth in each recovery well. The average water depth ranged from 4.9 feet in RW-1 to 8.6 feet in RW-3, as indicated in Table 6.4. The available drawdown in each recovery well in also indicated in Table 6.4. The available drawdown is used herein to mean the maximum drawdown achievable with the existing well construction and the existing recovery pumps. The available drawdown ranges from a low of 0.4 feet in RW-1 to 2.6 feet in RW-3.

7.0 ORS EVALUATION AND RECOMMENDATIONS

In this section, the ORS is evaluated with respect to satisfying the system objectives set forth in Section 4.1. Specific recommendations are provided to enhance system effectiveness.

7.1 WITHDRAWAL AND TREATMENT OF VOC-CONTAMINATED GROUND WATER

Based on analytical results shown in Table 6.3, all VOCs are being removed from contaminated ground water passing through the ORS to levels below the analytical detection limit (<5 ug/L). There are no instances in which the ORS effluent contained any measurable VOCs. Although Total VOC concentrations have fluctuated in the ground water over the life of the system, VOC levels appear in general to be decreasing in ground water.

7.2 ORS CAPTURE ZONES

7.2.1 Plume Capture

Potentiometric surface contours shown in Figures 6.2 and 6.3 indicate that during the period of evaluation, the ORS is providing capture of ground water at the downgradient edge of the plume, between RW-1 and RW-2. The capture pattern between RW-2 and RW-3 does not indicate significant ground water capture, although the ground water would continue to flow toward RW-1 and RW-2. As shown in Figures 6.2 and

6.3, there is flow reversal at IT-2 and MW-35 along the south edge of the plume. There appears to be dewatering of the storm sewer trench upgradient of RW-3, and if so, there could be temporary and limited capture of ground water in the vicinity of MW-27, MW-28 and MW-29. However ground water may also be flowing beneath the storm sewer, and any further capture could cease once ground water levels are below the sewer invert. Thus, the present system may not provide reliable capture of ground water in the MW-27/MW-29 area.

7.2.2 Potentiometric Surface Depression

As shown in Table 6.2, the ORS has not reliably lowered the potentiometric surface below the storm sewer invert. The potentiometric surface must be lowered an additional 1.04 to 2.40 feet to prevent continued infiltration of ground water into the storm sewer.

7.3 RECOVERY WELL YIELDS AND AVAILABLE DRAWDOWN

7.3.1 Recovery Well Yields

As shown in Figure 6.4, the characteristic curve for drawdown vs. pumping rate at RW-2 indicates that pumping rates from 10 to 13 gpm are needed to sustain a drawdown of 2 to 3 feet at this location. Cumulative pumpage data indicate average pumping rates of 1.5 gpm for RW-1, 2.0 gpm for RW-2 and 2.8 gpm for RW-3 since August 4, 1995. Assuming that the data for RW-2 are generally applicable to the other recovery wells, the pumping rates achieved to date are not adequate to achieve the draw down needed to maintain capture zones and lower the potentiometric surface below the storm sewer inverts.

7.3.2 System Reliability

System shutdowns will limit the ability of the ORS to maintain adequate pumping rates. The most frequent single cause of system shutdown identified (5 instances) was a blocked system discharge line, mainly the result of lime buildup. Handex has replaced the discharge line "P" trap with a removable trap which can be cleaned monthly, thereby reducing the potential for discharge line blockage to shut down the system.

In general, the majority of the system shutdowns were related to air leaks and malfunctioning pneumatic parts (pump controllers, compressor), and switching to more reliable pumps and controls should reduce system downtime. The changes should also make the autodialler more effective in signaling system malfunctions.

7.3.3 Available Drawdown

As shown in Table 6.4, the existing recovery well and pneumatic pump configurations limit the drawdown available to the system. The pumps operate by using pressurized air to force water out of the pump fill chamber and depend on gravity flow for ground water to fill the pump before it can cycle again. The pumps must be fully submerged for ground water to fill the pump chamber. At RW-1, Table 6.2 indicates that 1.69 feet of dewatering is required at that location to lower the potentiometric surface below the storm sewer invert, but only 0.4 feet of additional drawdown is presently available. At RW-2, 1.61 feet of additional drawdown is needed, but only 0.7 feet is available. AT RW-3, 1.74 feet of additional drawdown is needed and 2.6 feet are available, so if higher pumping rates could be sustained at W-3, the system could successfully lower the potentiometric surface below the storm sewer invert.

The limitation in drawdown is further demonstrated by a comparison of the rated pump capacities to the actual pumping rates. The pumps are rated for flows up to 8 and 10 gpm. However, a review of the actual ground water recovery rates indicates individual well recovery rates averaging 1.5 to 2.8 gpm. The difference is primarily caused by the limited submergence of the pumps and the corresponding limited available drawdown. Shutdowns occasioned by malfunctions of pneumatic components and controls will worsen the situation, but the system cannot achieve the overall drawdown needed even if it operates without malfunction. Switching to shorter pumps will greatly increase the drawdown available at each recovery well

7.4 RECOMMENDATIONS

7.4.1 Recommended Changes to Existing System

The above comparisons indicate the major limitations of the present system in achieving further depression of the potentiometric surface and increasing capture zones:

- Present maximum recovery well pumping rates are 8 to 10 gpm, and pumps should have a sustained rate of 10 to 13 gpm.

- System shutdowns are often the result of malfunctioning pneumatic components.
- The length of the pneumatic pumps account for the majority of the submerged well depth and limits available drawdown.

The replacement of the existing pumps with other submersible pneumatic pumps would not be expected to significantly change achievable recovery rates and drawdown. Pneumatic pumps are commonly used in ground water recovery systems and are appropriate for many sites, but do not offer the specific performance characteristics required to meet the ORS objectives at this site. It is recommended that the pneumatic recovery system be replaced with a system using electric submersible pumps. The latter are available with the necessary pumping capacity in configurations that can operate in as little as 26 inches of water. The pumps must be carefully selected to ensure that the pump size and capabilities match the ground water recharge rates in each recovery well. This will ensure that the pumps cycle correctly and motor life is not compromised, and ensure that influent ground water matches the stripper capacity.

The existing treatment building should have sufficient room for the electric recovery system since the 7.5 hp compressor would no longer be present. The additional system electrical requirements may require an upgrade of the existing electrical system; however there are already electrical conduits installed between the building and each well head to accommodate electric lines. While the existing stripper unit has a rated hydraulic capacity of 50 gpm, any significant increase in flow to the unit should be accompanied by an evaluation of treatment capacity. Likewise, if an additional recovery well is installed (see next section) the capacity of the stripper system should be assessed.

It was noted in Section 6.4 that the autodialler is not responding to all cases of system shutdown. If the pneumatic system is replaced by an electric system, then many of the past causes of system shutdown will be eliminated. Since the "P" trap which caused system shutdown due to lime blockage is being cleaned monthly, this should eliminate the other major cause of system shutdown. However, the autodialler system should be checked to ensure that it is reliably sounding an alarm in the event of a power outage, or high or low pressure at the stripper, and replaced or repaired as needed.

7.4.2 Recommended Additions to Existing System

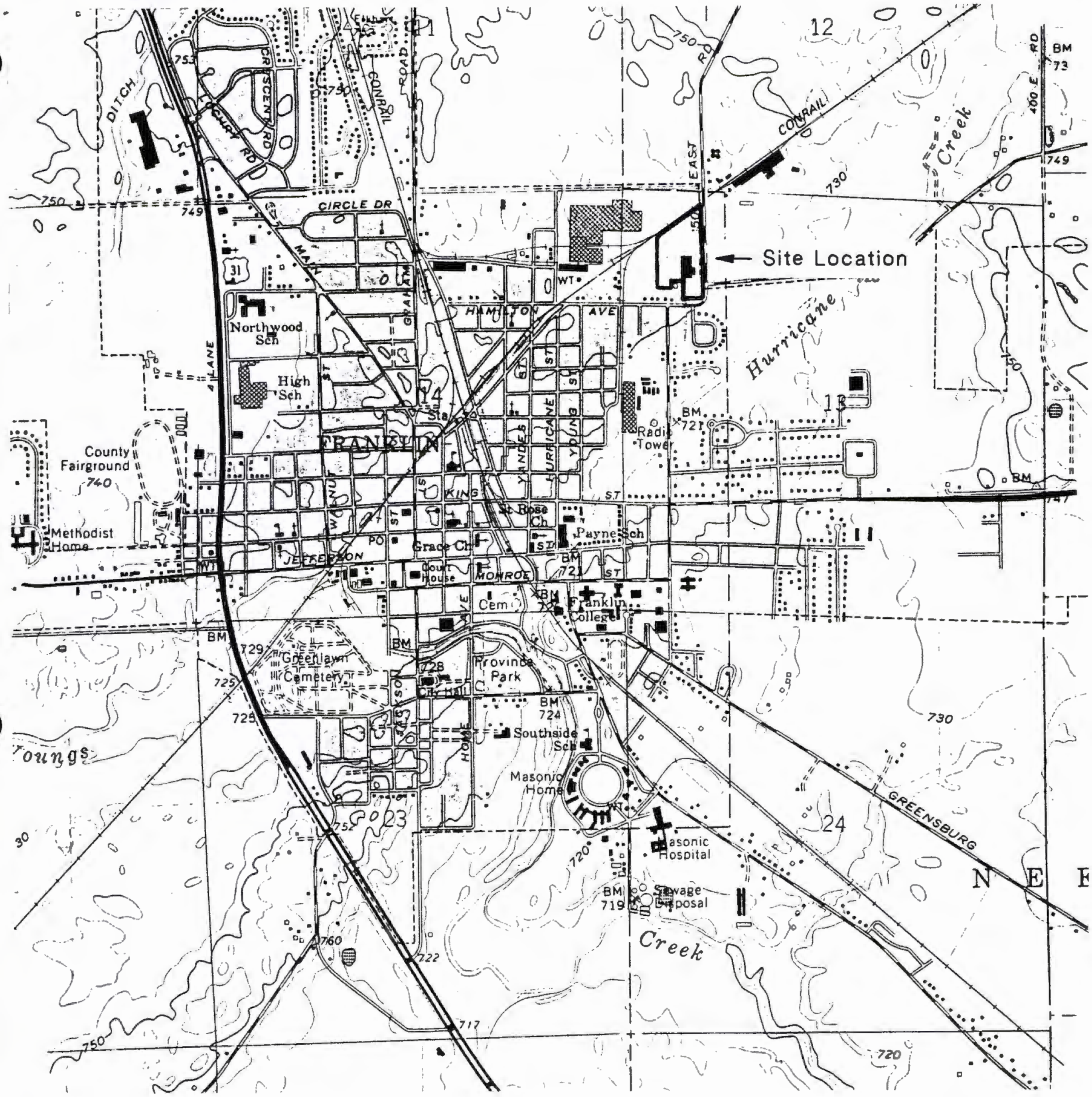
The existing recovery system may not provide adequate capture of ground water in the vicinity of MW-27, MW-28 and MW-29. Therefore, it is recommended that a fourth recovery well be installed west of MW-

28 along the property line. This will recover the contaminated ground water in this area and lower the potentiometric surface below the storm sewer invert. As before, a pump test of the new recovery well is recommended to assist in selecting the correct pump size, and to provide information to evaluate the capacity of the existing air stripper to treat the additional flow. The existing treatment building should have room to accommodate the new well lines, and there is a 4-inch PVC pipe and electric conduit stubbed into the floor at the northwest corner of the building to provide for a fourth recovery well.

The compatibility of the ORS with other potential corrective measures, specifically soil vapor extraction (SVE) and air sparging is considered here since the technologies were proposed in the CMS report for use in two of the corrective measure Alternatives (Alternative 3 and Alternative 5). In SVE, air is withdrawn from subsurface soils through extraction wells operated under a vacuum. Air may be allowed to flow naturally downward to the subsurface from the soil surface, or it may be supplied by air injection wells to enhance system performance. Volatile organic compounds in the soils vaporize and the vapor-laden air is extracted and treated as necessary. This method is often used to remove VOCs located in unsaturated soils above the water table, which may act as sources for ground water. SVE is not generally applicable to saturated soils; in these instances, soil dewatering is necessary to maximize SVE effectiveness.

Air sparging is typically used to reduce VOC levels in ground water. Air is injected into ground water by wells that have screened intervals below the water table. Volatile compounds in the ground water vaporize and are transferred to the sparge air, and this air is recovered in SVE wells and treated as necessary. To maximize the effectiveness of air sparging, air should be injected throughout the entire vertical distance of the saturated zone.

By comparison, the ORS relies on maximum drawdown to create an effective capture zone, to recover and treat VOC-containing ground water and to lower the potentiometric surface below the invert of the storm sewer. There is, therefore, the potential for incompatibility between the ORS and the use of air sparging in the same area, in that maximizing the performance of one system will minimize the performance of the other. In that a principal goal of the corrective measures in place (and proposed) is the prevention of further VOC migration from the site, ground recovery must be a priority consideration. Focused SVE, and air sparging, if required, may continue to have some applicability in areas where VOC-containing soils are present.



Base taken from USGS Franklin, Ind.
7.5' Topographic Quadrangle, 1980.

NORTH

0 2000
Feet

1:1
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FIGURE 2.1

SITE LOCATION MAP

FORMER AMPHENOL FACILITY
FRANKLIN, INDIANA

EARTH TECH

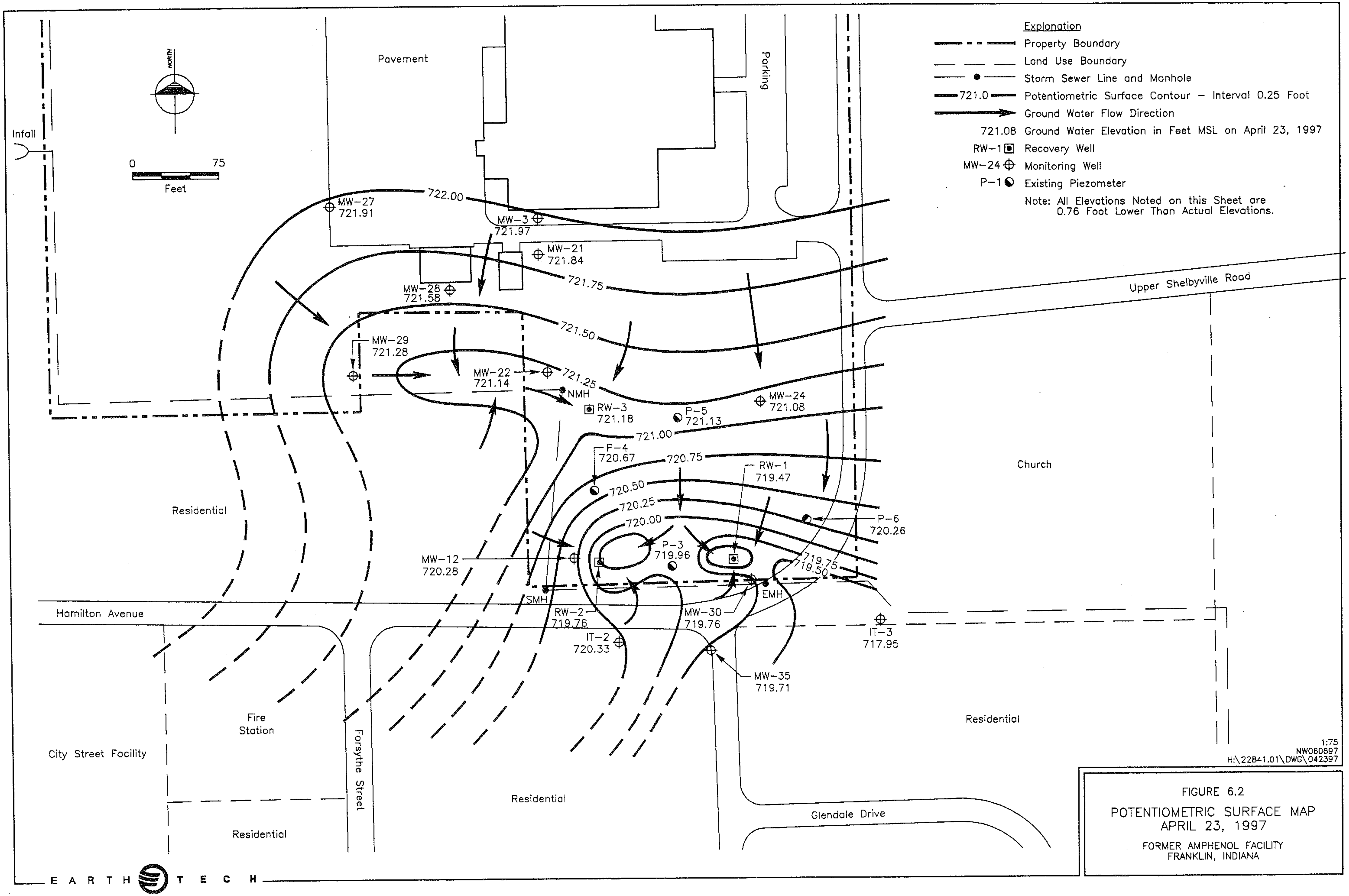
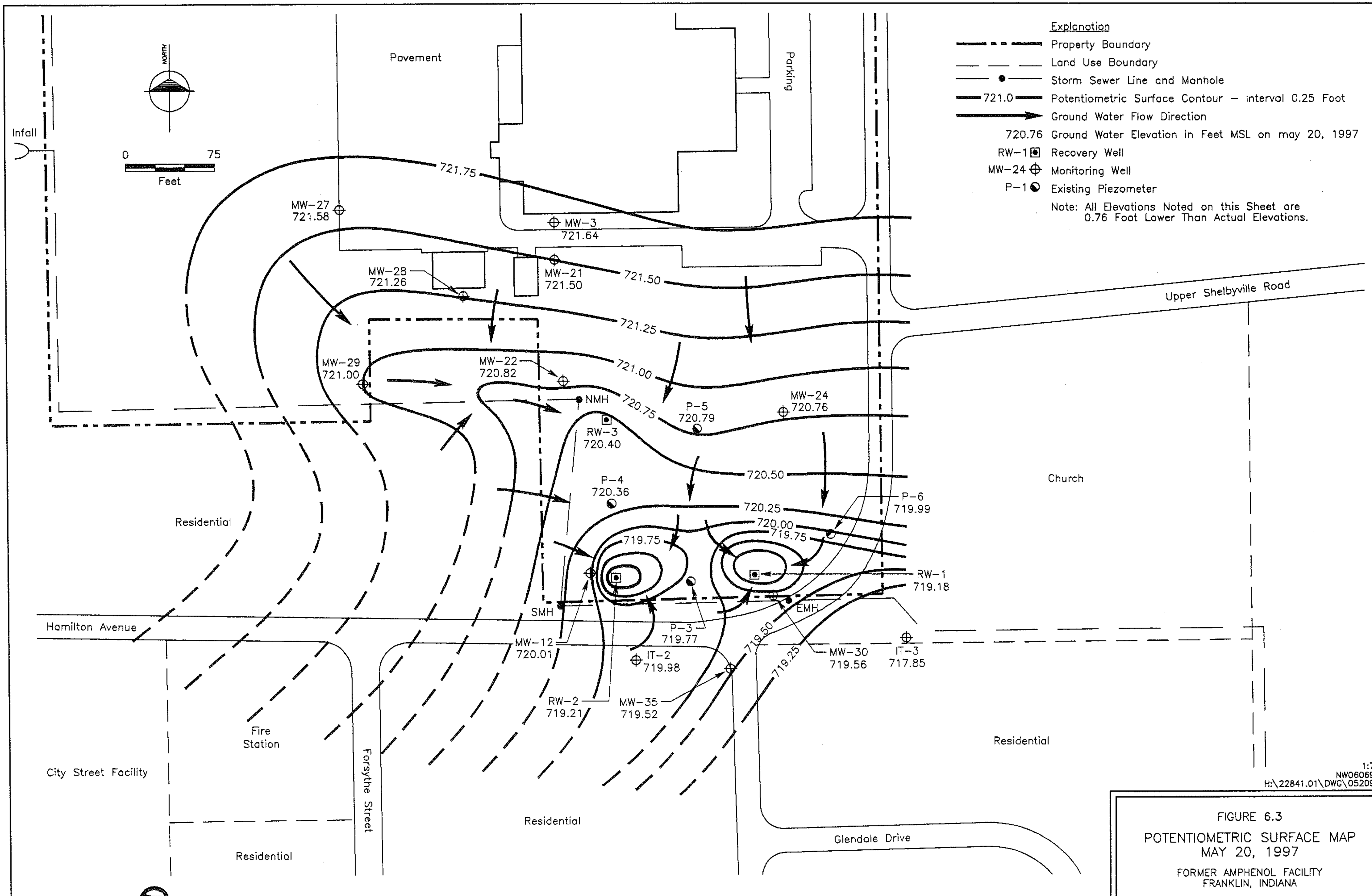


FIGURE 6.2
POTENTIOMETRIC SURFACE MAP
APRIL 23, 1997
FORMER AMPHENOL FACILITY
FRANKLIN, INDIANA



1:75
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FIGURE 6.3

POTENTIOMETRIC SURFACE MAP
MAY 20, 1997

FORMER AMPHENOL FACILITY
FRANKLIN, INDIANA

EARTH TECH

Figure 6.4 Calculated Characteristic Curve of Recovery Well RW-2

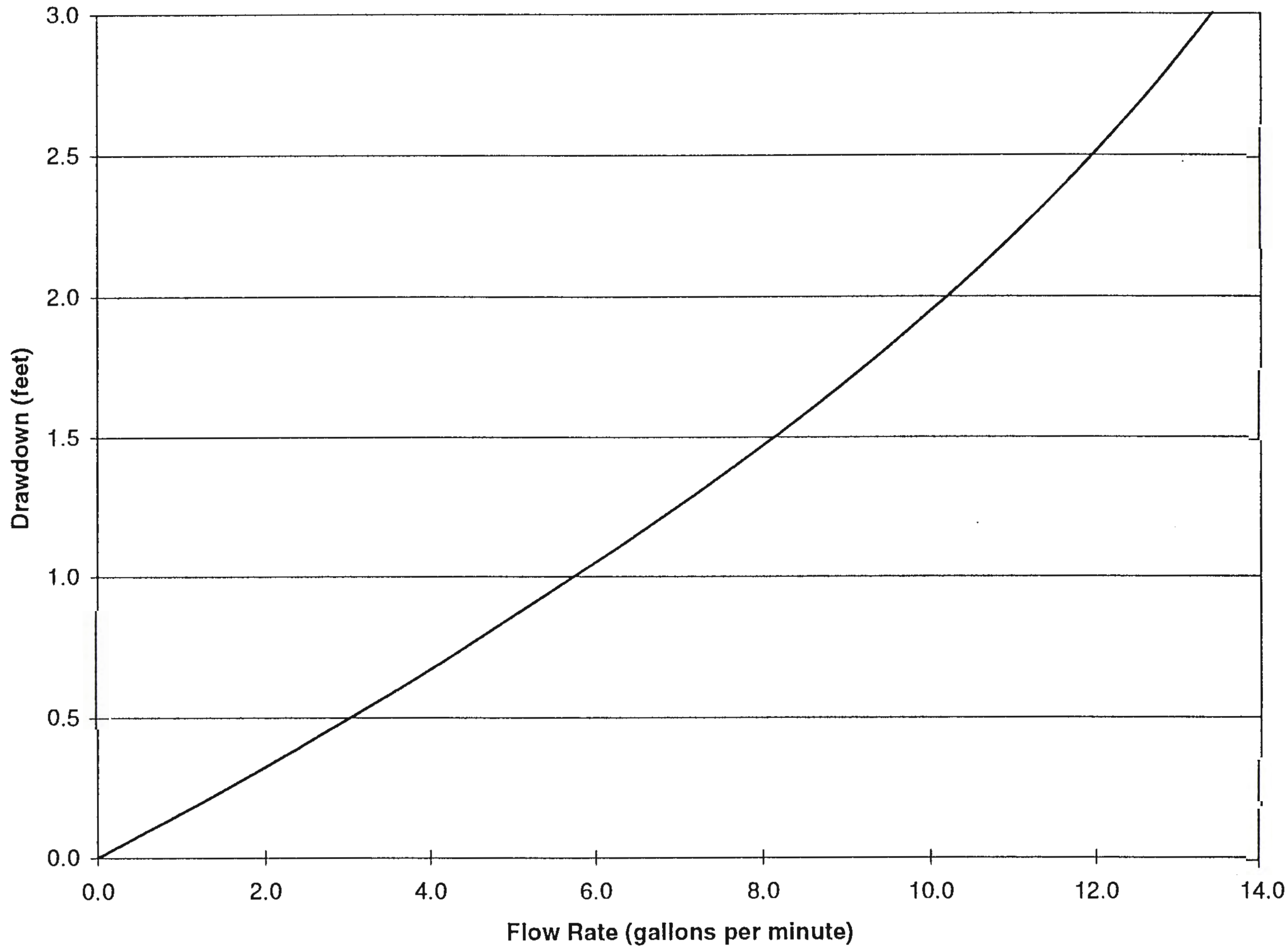


Table 6.1 Ground Water Level Measurements in the Vicinity of the ORS

Well Number	Date	TOC Elevation (feet)	Depth to Water (feet)	Ground Water Elevation (feet)
IT-2	2/23/95	732.25	13.25	719.00
	3/2/95		13.15	719.10
	8/29/95		12.36	719.89
	11/7/95		13.07	719.18
	4/12/96		13.45	718.80
	5/29/96		10.82	721.43
	6/4/96		11.08	721.17
	7/8/96		11.84	720.41
	8/1/96		12.04	720.21
	9/12/96		12.58	719.67
	10/17/96		12.37	719.88
	11/25/96		12.26	719.99
	12/11/96		12.02	720.23
	1/24/97		11.71	720.54
	2/21/97		11.85	720.40
	3/14/97		11.48	720.77
	4/23/97		12.02	720.23
	5/20/97		12.27	719.98
IT-3	2/23/95	728.71	11.20	717.51
	3/2/95		11.18	717.53
	8/29/95		9.52	719.19
	11/7/95		11.14	717.57
	4/12/96		12.09	716.62
	5/29/96		9.41	719.30
	6/4/96		10.11	718.60
	7/8/96		10.44	718.27
	8/1/96		10.63	718.08
	9/12/96		10.85	717.86
	10/17/96		10.97	717.74
	11/25/96		10.82	717.89
	12/11/96		10.79	717.92
	1/24/97		10.55	718.16
	2/21/97		10.80	717.91
	3/14/97		10.51	718.20
	4/23/97		10.76	717.95
	5/20/97		10.86	717.85
MW-3	2/23/95	736.44	16.55	719.89
	3/2/95		16.49	719.95
	8/29/95		15.23	721.21
	11/7/95		16.40	720.04
	4/12/96		14.91	721.53
	5/29/96		13.16	723.28
	6/4/96		13.15	723.29
	7/8/96		14.03	722.41
	8/1/96		14.53	721.91
	9/12/96		15.33	721.11
	10/17/96		15.33	721.11
	11/25/96		15.29	721.15
	12/11/96		14.95	721.49
	1/24/97		14.50	721.94
	2/21/97		14.50	721.94
	3/14/97		14.06	722.38
	4/23/97		14.47	721.97
	5/20/97		14.80	721.64

Table 6.1 (cont.)

Well Number	Date	TOC Elevation (feet)	Depth to Water (feet)	Ground Water Elevation (feet)
MW-12	2/23/95	736.38	17.28	719.10
	3/2/95		17.27	719.11
	8/29/95		16.43	719.95
	11/7/95		17.18	719.20
	4/12/96		16.21	720.17
	5/29/96		15.07	721.31
	6/4/96		15.31	721.07
	7/8/96		15.88	720.50
	8/1/96		16.16	720.22
	9/12/96		16.59	719.79
	10/17/96		16.47	719.91
	11/25/96		16.32	720.06
	12/11/96		16.12	720.26
	1/24/97		15.89	720.49
	2/21/97		15.96	720.42
	3/14/97		15.66	720.72
	4/23/97		16.10	720.28
	5/20/97		16.37	720.01
MW-21	2/23/95	737.91	18.03	719.88
	3/2/95		18.02	719.89
	8/29/95		16.81	721.10
	11/7/95		17.92	719.99
	4/12/96		16.48	721.43
	5/29/96		14.82	723.09
	6/4/96		14.82	723.09
	7/8/96		15.67	722.24
	8/1/96		16.16	721.75
	9/12/96		16.89	721.02
	10/17/96		16.89	721.02
	11/25/96		16.85	721.06
	12/11/96		16.53	721.38
	1/24/97		16.10	721.81
	2/21/97		16.11	721.80
	3/14/97		15.64	722.27
	4/23/97		16.07	721.84
	5/20/97		16.41	721.50
MW-22	2/23/95	737.64	18.03	719.61
	3/2/95		18.12	719.52
	8/29/95		17.05	720.59
	11/7/95		17.90	719.74
	4/12/96		16.74	720.90
	5/29/96		15.52	722.12
	6/4/96		15.63	722.01
	7/8/96		16.22	721.42
	8/1/96		16.58	721.06
	9/12/96		17.15	720.49
	10/17/96		17.04	720.60
	11/25/96		16.99	720.65
	12/11/96		16.76	720.88
	1/24/97		16.46	721.18
	2/21/97		16.50	721.14
	3/14/97		16.15	721.49
	4/23/97		16.45	721.19
	5/21/97		16.82	720.82

Table 6.1 (cont.)

Well Number	Date	TOC Elevation (feet)	Depth to Water (feet)	Ground Water Elevation (feet)
MW-24	2/23/95	736.02	16.85	719.17
	3/2/95		16.55	719.47
	8/29/95		15.59	720.43
	11/7/95		16.41	719.61
	4/12/96		15.29	720.73
	5/29/96		13.77	722.25
	6/4/96		13.80	722.22
	7/8/96		14.54	721.48
	8/1/96		15.01	721.01
	9/12/96		15.61	720.41
	10/17/96		15.66	720.36
	11/25/96		15.61	720.41
	12/11/96		15.33	720.69
	1/24/97		14.96	721.06
	2/21/97		15.24	720.78
	3/14/97		14.62	721.40
	4/23/97		14.94	721.08
	5/20/97		15.26	720.76
MW-27	2/23/95	736.63	16.54	720.09
	3/2/95		16.60	720.03
	8/29/95		15.37	721.26
	11/7/95		16.66	719.97
	4/12/96		15.01	721.62
	5/29/96		13.23	723.40
	6/4/96		13.44	723.19
	7/8/96		14.38	722.25
	8/1/96		14.79	721.84
	9/12/96		15.62	721.01
	10/17/96		15.56	721.07
	11/25/96		15.45	721.18
	12/11/96		15.11	721.52
	1/24/97		14.63	722.00
	2/21/97		14.75	721.88
	3/14/97		14.28	722.35
	4/23/97		14.72	721.91
	5/20/97		15.05	721.58
MW-28	2/23/95	738.04	18.18	719.86
	3/2/95		18.21	719.83
	8/29/95		17.03	721.01
	11/7/95		18.19	719.85
	4/12/96		16.72	721.32
	5/29/96		15.21	722.83
	6/4/96		15.32	722.72
	7/8/96		16.12	721.92
	8/1/96		16.54	721.50
	9/12/96		17.25	720.79
	10/17/96		17.20	720.84
	11/25/96		17.10	720.94
	12/11/96		16.81	721.23
	1/24/97		16.39	721.65
	2/21/97		16.49	721.55
	3/14/97		16.05	721.99
	4/23/97		16.46	721.58
	5/20/97		16.78	721.26

Table 6.1 (cont.)

Well Number	Date	TOC Elevation (feet)	Depth to Water (feet)	Ground Water Elevation (feet)
MW-29	2/23/95	737.61	17.92	719.69
	3/2/95		17.92	719.60
	8/29/95		16.83	720.78
	11/7/95		17.99	719.62
	4/12/96		16.46	721.15
	5/29/96		15.01	722.60
	6/4/96		15.19	722.42
	7/8/96		16.04	721.57
	8/1/96		16.40	721.21
	9/12/96		17.15	720.46
	10/17/96		17.02	720.59
	11/25/96		16.93	720.68
	12/11/96		16.61	721.00
	1/24/97		16.24	721.37
	2/21/97		16.31	721.30
	3/14/97		15.91	721.70
	4/23/97		16.33	721.28
	5/20/97		16.61	721.00
MW-30	2/23/95	734.84	15.70	719.14
	3/2/95		15.72	719.12
	8/29/95		15.54	719.30
	11/7/95		15.93	718.91
	4/12/96		14.95	719.89
	5/29/96		14.10	720.74
	6/4/96		14.38	720.46
	7/8/96		14.84	720.00
	8/1/96		15.06	719.78
	9/12/96		15.28	719.56
	10/17/96		15.58	719.26
	11/25/96		15.13	719.71
	12/11/96		14.98	719.86
	1/24/97		14.71	720.13
	2/21/97		14.95	719.89
	3/14/97		14.70	720.14
	4/23/97		15.08	719.76
	5/20/97		15.28	719.56
MW-35	4/23/97	730.29	10.58	719.71
	5/20/97		10.77	719.52
RW-1	8/29/95	730.97	2.58	728.39
	11/7/95		not recorded	-
	4/12/96		11.02	719.95
	5/29/96		10.84	720.13
	6/4/96		11.12	719.85
	7/8/96		11.28	719.69
	8/1/96		not recorded	NA
	9/12/96		11.55	719.42
	10/17/96		12.50	718.47
	11/25/96		11.23	719.74
	12/11/96		11.06	719.91
	1/24/97		10.90	720.07
	2/21/97		11.06	719.91
	3/14/97		10.73	720.24
	4/23/97		11.50	719.47
	5/21/97		11.79	719.18

Table 6.1 (cont.)

Well Number	Date	TOC Elevation (feet)	Depth to Water (feet)	Ground Water Elevation (feet)
RW-2	8/29/95	732.05	4.42	727.63
	11/7/95		nor recorded	-
	4/12/96		12.72	719.33
	5/29/96		11.50	720.55
	6/4/96		11.88	720.17
	7/8/96		12.48	719.57
	8/1/96		12.76	719.29
	9/12/96		13.25	718.80
	10/17/96		12.86	719.19
	11/25/96		12.26	719.79
	12/11/96		11.89	720.16
	1/24/97		11.76	720.29
	2/21/97		11.80	720.25
	3/14/97		11.45	720.60
	4/23/97		12.29	719.76
	5/21/97		12.84	719.21
RW-3	8/29/95	733.19	4.08	729.11
	11/7/95		not recorded	-
	4/12/96		13.07	720.12
	5/29/96		11.73	721.46
	6/4/96		12.68	720.51
	7/8/96		13.26	719.93
	8/1/96		13.10	720.09
	9/12/96		13.40	719.79
	10/17/96		12.78	720.41
	11/25/96		12.68	720.51
	12/11/96		12.51	720.68
	1/24/97		12.26	720.93
	2/21/97		12.20	720.99
	3/14/97		11.90	721.29
	4/23/97		12.01	721.18
	5/21/97		12.79	720.40
P-3	4/23/97	735.52	15.56	719.96
	5/20/97		15.75	719.77
P-4	4/23/97	736.84	16.17	720.67
	5/20/97		16.48	720.36
P-5	4/23/97	736.73	15.60	721.13
	5/20/97		15.94	720.79
P-6	4/23/97	735.17	14.95	720.22
	5/20/97		15.18	719.99

Note: All tabulated elevations are 0.76 feet lower than actual elevations

Table 6.2 WATER LEVELS RELATIVE TO STORM SEWER INVERT ELEVATION

Observation Location	Adjacent Storm Sewer Invert Elevation (feet msl)	Water Levels (a) (feet msl) Seasonal Low	Average	Seasonal High	Additional Dewatering Required (b) (feet)
north manhole	719.72	NA	NA	NA	NA
south manhole	719.16	NA	NA	NA	NA
east manhole	718.01	NA	NA	NA	NA
MW-29	720.43	720.46	721.31	722.6	2.17
MW-22	719.72	720.49	721.14	722.12	2.40
RW-3	719.72	719.79	720.61	721.46	1.74
P-4 (c)	719.48	NA	720.52	NA	1.04
MW-12	719.07	719.79	720.40	721.31	2.24
RW-2	718.99	718.80	719.83	720.60	1.61
P-3 (c)	718.75	NA	719.87	NA	1.12
RW-1	718.55	718.47	719.74	720.24	1.69
MW-30	718.50	719.26	719.94	720.74	2.24

(a) Based on monitoring interval from April 1996 to May 1997
(b) Seasonal high water level minus storm sewer invert elevation
(c) Piezometers P-3 and P-4 were installed for thois evaluation. No seasonal data are available.

Table 6.3 Influent and Effluent Water Quality for VOCs (ug/L)

Date/Parameter	RW-1	RW-2	RW-3	Total VOCs	Effluent
5/3/95					
1,1-dicloroethane	33	47	28/25		not sampled
1,1-dichloroethene	<5	8.1	<1		not sampled
cis-1,2-dichloroethene	<5	3.9	<5		not sampled
tetrachloroethene	100	1,500	160		not sampled
1,1,1-trichloroethane	200	960	540		not sampled
trichloroethene	520	4,300	2,900		not sampled
Total VOCs	853	6,819	3,628	11,300	not sampled
8/3/95					
1,1-dicloroethane	31	48	53		<5
1,1-dichloroethene	<5	<5	<5		<5
cis-1,2-dichloroethene	<5	<5	<5		<5
tetrachloroethene	170	1,500	16		<5
1,1,1-trichloroethane	180	1,100	560		<5
trichloroethene	400	3,000	870		<5
Total VOCs	781	5,648	1,499	7,928	<5
11/7/95					
1,1-dicloroethane	30	58	48		<5
1,1-dichloroethene	<5	9.1	6.9		<5
cis-1,2-dichloroethene	<5	5.3	<5		<5
tetrachloroethene	<5	2,100	1,400		<5
1,1,1-trichloroethane	190	1,300	950		<5
trichloroethene	390	2,200	1,700		<5
Total VOCs	610	5,672	4,105	10,387	<5
4/12/96					
1,1-dicloroethane	not sampled	<5	<5		<5
1,1-dichloroethene	not sampled	<5	<5		<5
cis-1,2-dichloroethene	not sampled	<5	>5		<5
tetrachloroethene	not sampled	980	93		<5
1,1,1-trichloroethane	not sampled	530	450		<5
trichloroethene	not sampled	1,500	1,200		<5
Total VOCs	not sampled	3,010	1,743	NA	<5
7/8/96					
1,1-dicloroethane	14	31	39		<5
1,1-dichloroethene	<5	7.3	6.5		<5
cis-1,2-dichloroethene	<5	<5	<5		<5
tetrachloroethene	31	2,100	45		<5
1,1,1-trichloroethane	120	1,200	820		<5
trichloroethene	350	2,100	1,100		<5
Ttoal VOCs	515	5,438	2,010	7,963	<5
10/17/96					
1,1-dicloroethane	15	33	34		<5
1,1-dichloroethene	<5	<5	<5		<5
cis-1,2-dichloroethene	<5	<5	<5		<5
tetrachloroethene	29	2,600	2,600		<5
1,1,1-trichloroethane	150	680	720		<5
trichloroethene	1,800	2,900	2,900		<5
Total VOCs	1,994	6,213	6,254	14,461	<5
2/7/97					
1,1-dicloroethane	18	27	28		<5
1,1-dichloroethene	<5	<5	<5		<5
cis-1,2-dichloroethene	<5	<5	<5		<5
tetrachloroethene	<5	37	37		<5
1,1,1-trichloroethane	140	400	410		<5
trichloroethene	260	410	410		<5
Total VOCs	418	874	885	2,177	<5
5/8/97					
1,1-dicloroethane	9.9	24	24		<5
1,1-dichloroethene	<5	<5	<5		<5
cis-1,2-dichloroethene	<5	<5	<5		<5
tetrachloroethene	20	880	1,000		<5
1,1,1-trichloroethane	91	340	400		<5
trichloroethene	250	860	990		<5
Total VOCs	371	2,104	2,414	4,889	<5

Table 6.4 Available Drawdown in Existing Recovery Wells

	Recovery Well Elevations (feet)		
	RW-1	RW-2	RW-3
Ground Surface Elevation (from survey of manhole rim)	732.86	733.92	735.21
Top of Casing Elevation (from survey)	730.97	732.05	733.19
Bottom of Well Elevation (based on ground surface elev. - well depth from EMCON completion diagram)	714.86	713.12	712.01
Screened Interval (based on ground surface elev. - screened interval depth from EMCON completion diagram)	716.86 - 721.86	714.92 - 719.92	714.21 - 719.21
Average Water Level (based on water level measurements conducted between 4/12/96 and 5/20/97)	719.74	719.83	720.61
Average Water Depth in Well (average water level - bottom of well elevation)	**4.9**	**6.7**	**8.6**
Pump Length	3.0	5.0	5.0
Minimum Recommended Pump Submergence	1.0	0.5	0.5
Minimum Recommended Distance Between Pump and Bottom of Well	0.5	0.5	0.5
Required Water Depth for Pump Operation (sum of previous three entries)	4.5	6.0	6.0
Available Drawdown (average water depth - required water depth for pump operation)	**0.4**	**0.7**	**2.6**

Wehran EMCON Northeast

BORING/WELL No. RW-1

SHEET 1 of 1

PROJECT: AMPHENOL, FRANKLIN
PROJECT No: 04768.01
CLIENT: AMPHENOL
CONTRACTOR: EEI
RIG:

GS ELEV: 732
N-S COORD: 760.43
E-W COORD: 1934.91
WL REF ELEV: 732
DATE STARTED: 09-07-94
DATE FINISHED: 09-07-94
OPERATOR: R.SMITH
GEOLOGIST: D.KING

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
9-7-94		12.82	

	CASING	SAMPLE	TUBE	CORE
TYPE				
DIAM.				
WEIGHT				
FALL				

DEPTH (feet)	SAMPLE NUMBER	SAMPLE & TYPE	RECOVERY (inches)	N-VALUE	LOG	UNIFIED	FIELD DESCRIPTION	REMARKS
0–2.5							6" topsoil Brown slightly moist, SILT (ML)	
2.5–7							Brown slightly moist Clayey SILT (ML-CL)	5.25 bags Global #4 1 bag #7 cement-bentonite mixed to 11.8 #/gal
7–9.5							Brown slightly moist Sandy CLAY (SC-CL)	#4 sand to 9.1', #7 to 8 cement-bentonite to 1.5'
9.5–10.5							Brown slightly moist Clayey SAND (SC)	
10.5–15.5	SS1 SS2 SS3	X X X					Brown slightly moist fine SAND (SP-SM) with SAND and little fine Gravel-becomes gray wet with medium coarse GRAVEL (SP-GM) in seams without Gravel at 14'	Casing: 4" Sch. 40 PVC Screen: 0.01 inch wire-wrapped
15.5–18	SS4	X					Gray wet so Silty CLAY (CL)	
18							BOTTOM TEST HOLE at 18'	

WELL CONSTRUCT

Wehran EMCON Northeast

BORING/WELL No. RW-2

SHEET 1 of 1

PROJECT: 04768.01
PROJECT No: AMPHENOL
CLIENT: AMPHENOL, FRANKLIN
CONTRACTOR: EEI
RIG:

GS ELEV:	734
N-S COORD:	759.92
E-W COORD:	1817.95
WL REF ELEV:	734
DATE STARTED:	09-07-94
DATE FINISHED:	09-07-94
OPERATOR:	R.SMITH
GEOLOGIST:	D.KING

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
9-7-94		14.2	

	CASING	SAMPLE	TUBE	CORE
TYPE				
DIAM.				
WEIGHT				
FALL				

DEPTH (feet)	SAMPLE NUMBER	UNIFIED	FIELD DESCRIPTION
0			6" Topsoil
		ML	Brown slightly moist SILT (ML)
		SC	Brown moist Silty CLAY (SC)
8			Slightly moist with medium GRAVEL at 8.0'
10		SM	Brown slightly moist Silty Clayey SAND (SM) with medium GRAVEL
13	SS1	SM/SC	Brown slightly moist medium density Silty fine to medium SAND (SM) with Gravel
15	SS2		wet with seams of (SC) 0.1' - 0.2'
17	SS3	GM	Gravel with rust seams wet, hard Silty Sandy GRAVEL (GM)
19	SS4	CL	Gravel slightly moist, very dense Silty CLAY (CL) with fossil (carbon) vegetation
20.5	SS5		
21.5			BOTTOM TEST HOLE at 21.5'

REMARKS:

Run set to 20.8' #4 GLOBAL to 11.8', 3.5 bag #7 sand to 11.3, 1 bag 2 bags cement,1 bag bentonite mixed to 11.7#/gal placed to

Casing: 4" Sch. 40PVC

Screen: 0.01 inch wire-wrapped

Wehran EMCON Northeast

BORING/WELL No. RW-3

SHEET 1 of 1

PROJECT: 04768.01
PROJECT No: 04768.01
CLIENT: AMPHENOL, FRANKLIN
CONTRACTOR: EEI
RIG:

GS ELEV: 735
N-S COORD: 891.80
E-W COORD: 1812.22
WL REF ELEV: 735
DATE STARTED: 09-07-94
DATE FINISHED: 09-08-94
OPERATOR: R.SMITH
GEOLOGIST: D.KING

GROUNDWATER DATA (feet)

DATE	GW DEPTH	GW ELEV	INTAKE
9-8-94		-15.4'	

	CASING	SAMPLE	TUBE	CORE
TYPE				
DIAM.				
WEIGHT				
FALL				

DEPTH (feet)	SAMPLE NUMBER	UNIFIED	FIELD DESCRIPTION	REMARKS
0–0.5			6" Topsoil	
0.5–2.5		ML	Brown slightly moist SILT (ML)	
2.5–9		SC	Brown moist Clayey SAND (SC)	
9–18	SS1, SS2, SS3	SM	Brown slightly moist Silt fine to medium SAND (SM) very stiff with fine to medium Gravel becomes moist at 15.0' becomes gray wet medium stiff Silt fine to medium SAND (SM) with Gravel	RW set at 23.2' #4 Global Sand to 15.5' #7 Sand to 15.0' Cement bentonite mixed to 11#/gal to 1.5' below GSE 4 bags #4 Global 1 bag #7 Casing: 4" Sch. 40 PVC Screen: 0.01 inch wire-wrapped
18–23	SS4, SS5	SM/SP	Gravel wet stiff fine to medium SAND (SM-SP) with Silt	
23–26	SS6, SS7	CL	Gravel slightly moist very stiff Silty CLAY (CL) with fossil vegetation	
26			BOTTOM TEST HOLE at 26.0'	

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40

EARTH TECH

Well Completion Diagram

Well No.	P-3		
Project	Amphenol - CMS	Installed By	S. Sakora (AEC)
Time & Date: Started	1230 4/16/97	Inspected By	M.Lytle
Completed	1300 4/16/97		

Top of Guard Pipe at Latch with Lid Open — ______ FT. (MSL)

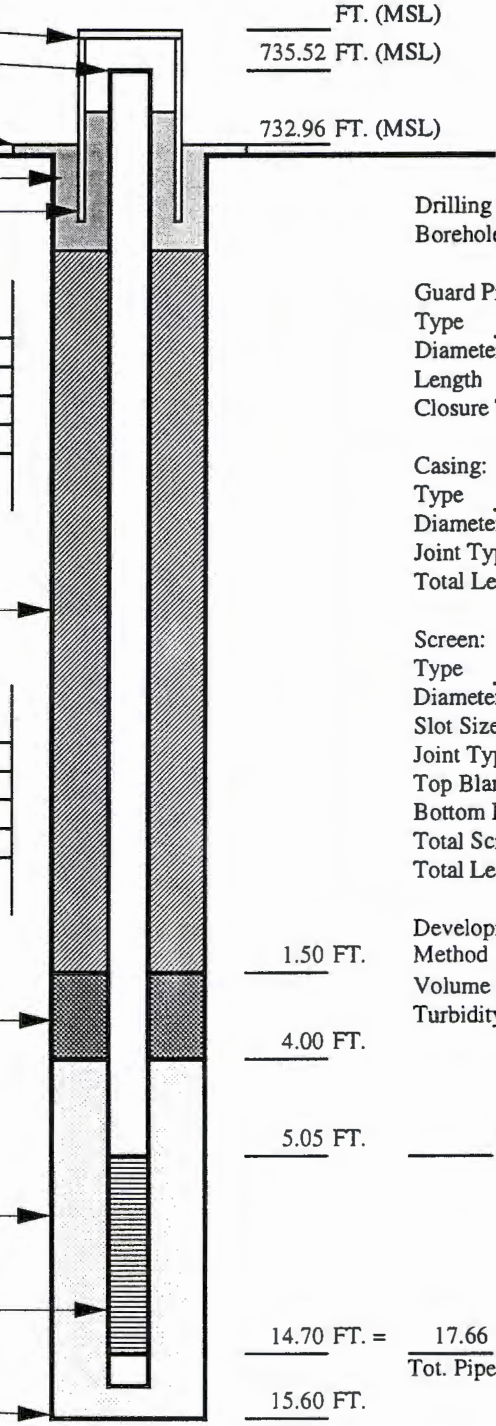
Permanent Mark on Top of Casing — 735.52 FT. (MSL)

Concrete Pad Below Latch

Ground Surface — 732.96 FT. (MSL)

Surface Seal

Guard Pipe



	Backfill	Surface Seal / Pad
Material	Volclay	Concrete
Size	Powder	Mix
Volume (calc.)		
Volume (actual)	5 gal.	2 bags
Placement Method	Tremia	Pour

Backfill

	Filter Pack	Annular Seal
Material	Quartz sand	Bentonite
Size	#5	Chips
Volume (calc.)		
Volume (actual)	4 bags	1 bag
Placement Method	Drop	Drop

Annular Seal

Filter Pack

Well Screen

Bottom of Borehole

Drilling Method	4 1/4" HSA
Borehole Diameter	8"
Guard Pipe:	
Type	Galvanized
Diameter	4"
Length	5 feet
Closure Type	Flip top
Casing:	
Type	PVC
Diameter	2"
Joint Type	Threaded
Total Length	7.51
Screen:	
Type	PVC
Diameter	2"
Slot Size	0.010"
Joint Type	Threaded
Top Blank	0.10'
Bottom Blank	0.40'
Total Screen	9.65'
Total Length	10.15'
Development:	
Method	Surge
Volume Discharged	
Turbidity at Completion	

1.50 FT.

4.00 FT.

5.05 FT. ______ FT. (MSL)

14.70 FT. = 17.66 Tot. Pipe - 0.0 Cut Off - 0.40 Bot. Blk. - 2.56 Stick

15.60 FT.

Well-3.xls

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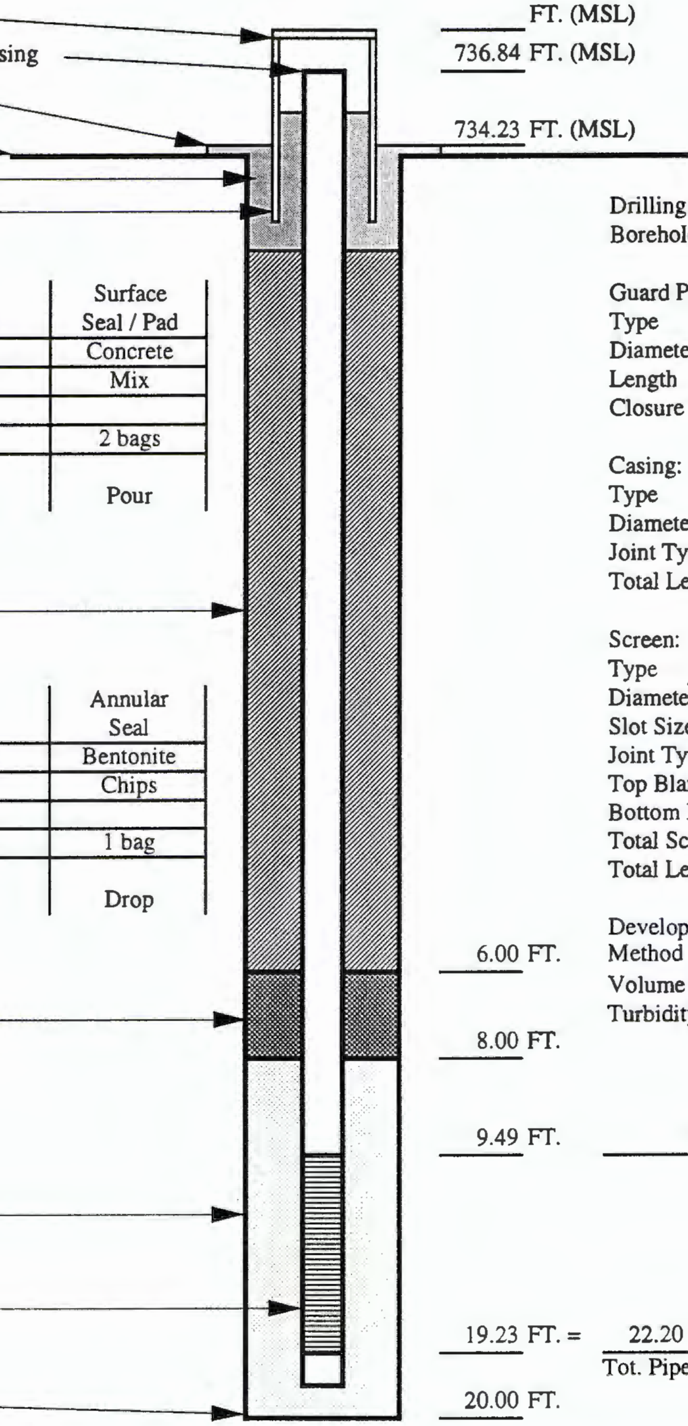
E A R T H T E C H

Well Completion Diagram

Well No.	P-4		
Project	Amphenol - CMS	Installed By	S. Sakora (AEC)
Time & Date: Started	1020 4/16/97	Inspected By	M.Lytle
Completed	1110 4/16/97		



	Backfill	Surface Seal / Pad
Material	Volclay	Concrete
Size	Powder	Mix
Volume (calc.)		
Volume (actual)	15 gal.	2 bags
Placement Method	Tremie	Pour

	Filter Pack	Annular Seal
Material	Quartz sand	Bentonite
Size	#5	Chips
Volume (calc.)		
Volume (actual)	4 bags	1 bag
Placement Method	Drop	Drop

Drilling Method: 4 1/4" HSA
Borehole Diameter: 8"

Guard Pipe:
Type: Galvanized
Diameter: 4"
Length: 5 feet
Closure Type: Flip top

Casing:
Type: PVC
Diameter: 2"
Joint Type: Threaded
Total Length: 12.00

Screen:
Type: PVC
Diameter: 2"
Slot Size: 0.010"
Joint Type: Threaded
Top Blank: 0.10'
Bottom Blank: 0.36'
Total Screen: 9.74'
Total Length: 10.20'

Development:
Method: Surge
Volume Discharged:
Turbidity at Completion:

Well-3.xls

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EARTH TECH

Well Completion Diagram

Well No. P-5

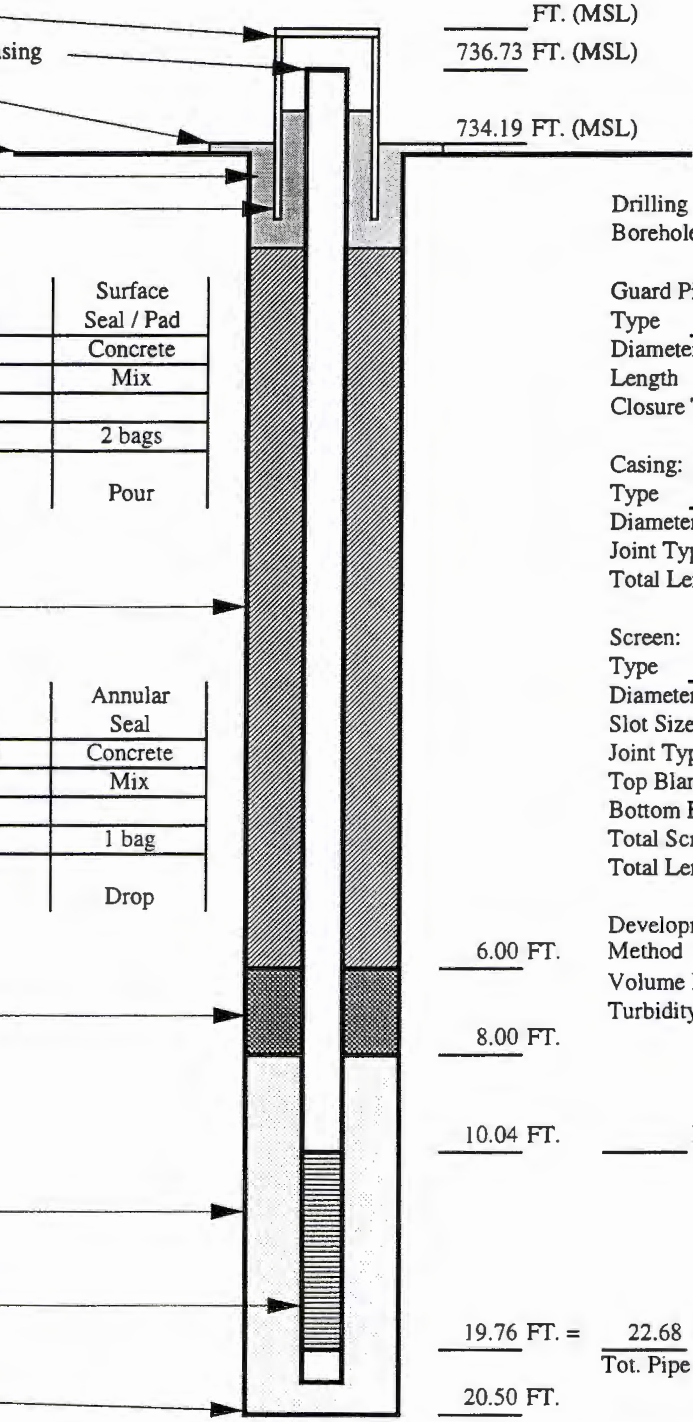
Project Amphenol

Time & Date: Started 1405 4/16/97

Completed 1440 4/16/97

Installed By S. Sakora (AEC)

Inspected By M. Lytle



Top of Guard Pipe at Latch with Lid Open ____ FT. (MSL)

Permanent Mark on Top of Casing 736.73 FT. (MSL)

Concrete Pad Below Latch

Ground Surface 734.19 FT. (MSL)

Surface Seal

Guard Pipe

	Backfill	Surface Seal / Pad
Material	Volclay	Concrete
Size	Powder	Mix
Volume (calc.)		
Volume (actual)	20 gal.	2 bags
Placement Method	Tremie	Pour

Backfill

	Filter Pack	Annular Seal
Material	Quartz sand	Concrete
Size	#5	Mix
Volume (calc.)		
Volume (actual)	4 bags	1 bag
Placement Method	Drop	Drop

Annular Seal

Filter Pack

Well Screen

Bottom of Borehole

6.00 FT.

8.00 FT.

10.04 FT. ____ FT. (MSL)

19.76 FT. = 22.68 (Tot. Pipe) - 0.00 (Cut Off) - 0.38 (Bot. Blk.) - 2.54 (Stick)

20.50 FT.

Drilling Method 4 1/4" HSA

Borehole Diameter 8"

Guard Pipe:

Type PVC

Diameter 4"

Length 5 ft.

Closure Type Flip-top

Casing:

Type PVC

Diameter 2"

Joint Type Threaded

Total Length 12.5

Screen:

Type PVC

Diameter 2"

Slot Size 0.010

Joint Type Threaded

Top Blank 0.08

Bottom Blank 0.38

Total Screen 9.72

Total Length 10.18

Development:

Method Surge

Volume Discharged

Turbidity at Completion

Well-3.xls

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EARTH TECH

Well Completion Diagram

Well No. P-6

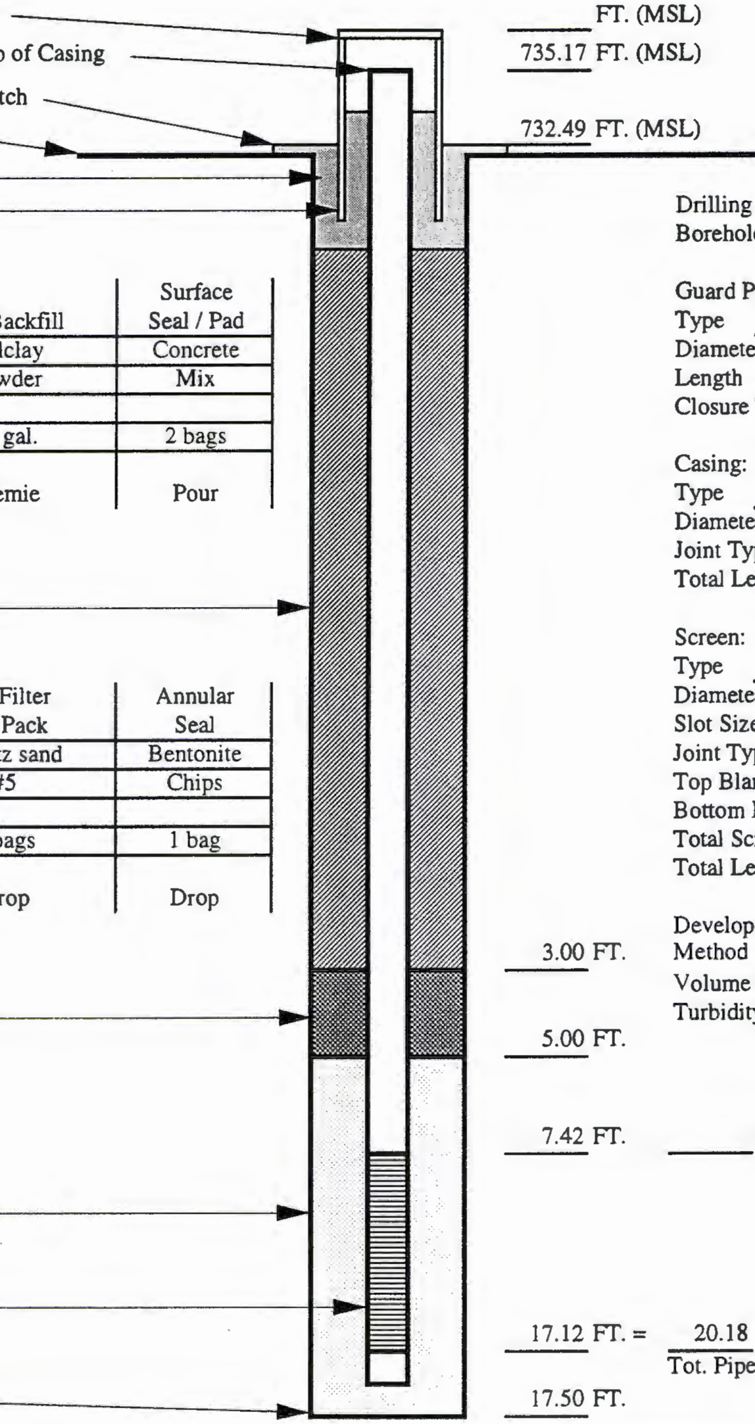
Project Amphenol - CMS

Time & Date: Started 1500 4/16/97

Completed 1530 4/16/97

Installed By S. Sakora (AEC)

Inspected By M. Lytle



	Backfill	Surface Seal / Pad
Material	Volclay	Concrete
Size	Powder	Mix
Volume (calc.)		
Volume (actual)	10 gal.	2 bags
Placement Method	Tremie	Pour

	Filter Pack	Annular Seal
Material	Quartz sand	Bentonite
Size	#5	Chips
Volume (calc.)		
Volume (actual)	4 bags	1 bag
Placement Method	Drop	Drop

Drilling Method 4 1/4" HSA

Borehole Diameter 8"

Guard Pipe:
- Type Galvanized
- Diameter 4"
- Length 5 ft.
- Closure Type Flip-top

Casing:
- Type PVC
- Diameter 2"
- Joint Type Threaded
- Total Length 10.00

Screen:
- Type PVC
- Diameter 2"
- Slot Size 0.010
- Joint Type Threaded
- Top Blank 0.10
- Bottom Blank 0.38
- Total Screen 9.70
- Total Length 10.18

Development:
- Method Surge
- Volume Discharged
- Turbidity at Completion

Well-3.xls

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EARTH TECH

Well Completion Diagram

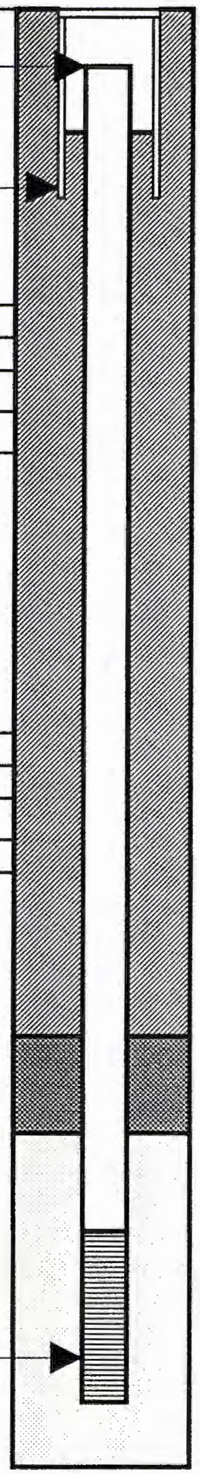
Well No. MW-35
Project Amphenol - CMS
Time & Date: Start 1640 4/16/97
Completed 1730 4/16/97

Installed By S.Sakora (AEC)
Inspected By M. Lytle

Ground Surface ____ FT. (MSL)

Reference Point (Top of Casing) ____ FT. (MSL)

Guard Pipe



Drilling Method 4 1/4" HSA
Borehole Diameter 8"

	Backfill	Surface Seal / Pad
Material	Bentonite	Concrete
Size	Chips	Mix
Volume (calc.)		
Volume (actual)	2 bags	3 bags
Placement Method	Drop	Pour

Guard Pipe:
Type Galvanized (Flush Mount)
Diameter 8"
Length 1.5 feet
Closure Type Bolt on lid

Casing:
Type PVC
Diameter 2"
Joint Type Threaded
Total Length 5.65

Backfill

	Filter Pack	Annular Seal
Material	Quartz sand	Bentonite
Size	#5	Chips
Volume (calc.)		
Volume (actual)	4 bags	1 bag
Placement Method	Drop	Drop

Screen:
Type PVC
Diameter 2"
Slot Size 0.010"
Joint Type Threaded
Top Blank 0.08'
Bottom Blank 0.30'
Total Screen 9.80'
Total Length 10.18'

2.00 FT.

Development:
Method Surge
Volume Discharged
Turbidity at Completion

Annular Seal

4.00 FT.

Filter Pack

6.00 FT.

Well Screen

FT. = 15.83 (Tot. Pipe) - 0.00 (Cut Off) - 0.30 (Bot. Blk.) - -0.27 (Stick)

15.80 FT.

Bottom of Borehole

16.50

WCDMSTR.XLS

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Well Characteristic Curve Calculations

Based on EMCON pump test results

Dupuit-Forchheimer Equation for radial flow in an unconfined aquifer:

Q = PI*K*(H^2-h^2)/(ln(R/r))

Assumptions:

K = (1)	2,069	gpd/ft2
R = (1)	195	ft
r = (2)	0.1667	ft
H = (3)	5.0	ft

Sensitivity Analysis:

K1 =	1000	gpd/ft^2
K2 =	3000	gpd/ft^2

for K			Flow Rate	
Drawdown s (feet)	Head h (feet)	Flow Rate Q (gpm)	for K1	for K2
0	5	0.00	0.00	0.00
0.1	4.9	0.63	0.31	0.92
0.2	4.8	1.25	0.61	1.82
0.3	4.7	1.86	0.90	2.70
0.4	4.6	2.45	1.19	3.56
0.5	4.5	3.03	1.47	4.40
0.6	4.4	3.60	1.74	5.23
0.7	4.3	4.16	2.01	6.03
0.8	4.2	4.70	2.27	6.82
0.9	4.1	5.23	2.53	7.59
1	4	5.75	2.78	8.34
1.1	3.9	6.26	3.02	9.07
1.2	3.8	6.75	3.26	9.78
1.3	3.7	7.23	3.49	10.48
1.4	3.6	7.69	3.72	11.15
1.5	3.5	8.15	3.94	11.81
1.6	3.4	8.59	4.15	12.45
1.7	3.3	9.02	4.36	13.07
1.8	3.2	9.43	4.56	13.67
1.9	3.1	9.83	4.75	14.26
2	3	10.22	4.94	14.82
2.1	2.9	10.60	5.12	15.37
2.2	2.8	10.96	5.30	15.90
2.3	2.7	11.32	5.47	16.41
2.4	2.6	11.65	5.63	16.90
2.5	2.5	11.98	5.79	17.37
2.6	2.4	12.29	5.94	17.82
2.7	2.3	12.59	6.09	18.26
2.8	2.2	12.88	6.23	18.68
2.9	2.1	13.16	6.36	19.08
3	2	13.42	6.49	19.46

Notes:
(1) - derived from EMCON pump test
(2) - radius of recovery well
(3) - average saturated thickness prior to pumping